The American Biology Teacher

JANUARY, 1960 VOLUME 22, No. 1

Armacost Memorial Issue

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Cover Photo

Richard Armacost is shown here conferring with a student in the Biology Teachers Conference Room at Purdue University. Here were collected periodicals, books, charts, teaching aids, and mimeographed material which Dick used in his work with teachers and student teachers. Courtesy Purdue Photographic Service.

THE AMERICAN BIOLOGY TEACHER

Publication of the National Association of Biology Teachers.

Issued monthly during the school year from October to May. Second class postage paid at Danville, Illinois.

Publication Office—Interstate Press, 19 N. Jackson St., Danville. Ill.

Editor—PAUL KLINGE, Coordinator for School Science, Indiana University, Bloomington, Indiana.

The Indiana University address will be the official editorial office.

Managing Editor—MURIEL BEUSCHLEIN, 6431 S. Richmond, Chicago 29, Ill.

Subscriptions, renewals, and notices of change of address should be sent to the Secretary-Treasurer, PAUL WEBSTER, Bryan City Schools, Bryan, Ohio. Correspondence concerning advertising should be sent to the Managing Editor.

Annual membership, including subscription, $6.00; subscription to Journal, $6.00; individual copies $.80; outside United States, $6.75; student membership, $2.00.

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Richard Armacost Memorial Issue

Memories are short, but memories of strong personalities remain with us for many, many years. The friends of Dick Armacost appreciate the truth of that statement for his personality was a strong and powerful one. It is the effort of this issue of the journal to remember Dick by bringing together articles written by some of his friends. While other materials must necessarily be included, the major part of this issue we hope accomplishes our purposes.

The news of his tragic death (February, 1959, ABT) was shocking to many people, but particularly did his friends find it hard to believe his personality had been removed from their lives. Yet it became obvious that he had not withdrawn completely, for his works, his influences, and his personality remained vividly in the minds of those who knew him.

This issue, then, is respectfully and lovingly dedicated to the memory of Richard Ralph Armacost, Co-Editor of this journal 1954-1959, and Professor of Biological Science Education, Purdue University.

Richard Armacost Biographical Data

Born: February 27, 1914, St. Bernard, Ohio
Died: February 26, 1959, Lebanon, Indiana
Family: Wife: Mrs. Katherine Armacost
Children: Betsy R. and Susan Armacost
Parents: Mr. and Mrs. Charles Armacost, Cincinnati, Ohio
A.B.: Miami University, 1936
M.S.: Iowa State University, 1938
Ph.D.: Iowa State University, 1940 (botany)
Teaching: Associate Professor of Morphology and Botany, Iowa State University, 1936-1940

Professional Activities

Associate Professor of Biological Education at Syracuse University 1940-1950

Member, Syracuse University Senate—1945-46, 1948-49.

Curator of the Natural Science Museum—1946, '47, '48, '49, '50.

Vice-President and Program Chairman for local chapter of Sigma Xi, honorary science fraternity, 1945, '46, '47.

Member of the Board of Directors of the Syracuse University.

Faculty Club 1944-45, 1946-47, 1948-49, 1949-50.

Chairman, The Doctorate Program for the Preparation of College Teachers in the Sciences—1949-50.

Member, The Committee on Preparation of College Teachers (All University) 1949-50.

Committee on General Education in Science (all sciences)—1949.

Delegate to United Nations Institute, sponsored by Dept. of Public Information of the Secretariat, United Nations and New York University, February 26-28, 1948.

Educational Testing Service. Test item writer—1948-49.

Manuscript reader and evaluator for the Macmillan Co.—1945, '46, '47, '48, '49, '50.

Member of the New York State Educational Department's General Science Syllabus Committee—1947, '48, '49, '50, '51.

Member of the New York State Education Department's Committee for Construction of the State General Science Examination—1945, '46, '47, '48, '49, '50.

Member of the New York State Education Department's Committee for Construction of the State Scholarship Examination—1944, '45, 46, '47, '48.

President, New York State Science Teacher's Association—1942-43.

Director at large of the New York State Science Teacher's Association—1943-44, '45, '46, '47, '48, '49, '50.

Chairman, New York State Science Teacher's Association Curriculum Committee—1945, '46, '47, '48, '49, '50.

National Science Teacher's Association Consultant for Science Consumer Education project—1946.

National Association for Research in Science Teaching. Member of the General Science Committee—1948, '49, '50.

Faculty Advisor of Kappa Phi Kappa, undergraduate men's service organization in Education—1946, '47, '48, '49, '50.

Member, Committee on Higher Degrees, School of Education—1947, '48, '49.

Editor-elect N.Y. State Teacher's Journal (Withdrew leaving state) 1950.

Professor of Biological Education at Purdue University 1950-1959

Extension Center Coordinator for the Department of Biological Sciences (four centers) 1951-56.

Head of the General Education Biology program—1950-56.

Originator, coordinator, writer, weekly partici-

pant of the radio program, "Ask the Biologist," sponsored by the Department of Biological Sciences—1951-56.

Producer of departmental television programs—1953-56.

Member of the all-University television committee—1951-52.

Member of the all-University radio and T.V. committee—1953-56.

School of Science representative for required senior course "Great Issues in Education"—1953-55.

Advisor to State Textbook Committee—1953-55.

Member School Survey Committees—1953-56 (Shelbyville, Terre Haute, Columbia City, Fort Wayne, Indiana) (and others)

Indiana State Department of Education consultant in Biology—1950-56.

Editor, Welch Biology and General Science Digest—1951-59.

Editor, The American Biology Teacher—1954-59.

Steering Committee, Southeastern Conference on Biology Teaching—1954.

Steering Committee, North Central Conference on Biology Teaching—1955.

Member sub-committee on pre-college education, National Research Council—1955-59.

Director—NSF Summer Institutes for Teachers of High School Biology—1957-1958.

PUBLICATIONS

1. The Border Parenchyma and the Vein Ribs of certain Dicotyledonous Leaves, Asbstract talk given before members of the general section of the Botanical Society of America. American Journal of Botany, Vol. 26, No. 10, Dec. 1939.
2. Conference Highlights, a report of the 1941 Syracuse University School of Education Sciences Conference. A twelve year program in science. School of Education, Syracuse University, 1941.
3. Some Things New York State Science Teachers Can Do. President's message. The Science Teachers News Bulletin, June, 1943.
4. The Science Teacher and His Profession. The Science Teachers News Bulletin, November 1943.
5. Why Teach Science in the Elementary School? The Science Teachers News Bulletin, April, 1944.
6. The Structure and Function of the Border Parenchyma of Certain Dicotyledonous Leaves. Proceeding of the Iowa Academy of Science, Vol. 51, 1944.
7. A Science Syllabus for Secondary Education 103 and Secondary Education 105b. School of Education, Syracuse University, 1944-45.
8. Armacost, Richard R., and Price, Roy A. Community Study, Supervisory District #1, Seneca County N. Y. Bureau of School Services, School of Education, Syracuse University.
9. Construction of Science Units by Elementary School Teachers. The Science Teachers News Bulletin, May, 1945.
10. General Science and General Science Teacher Preparation. The Science Teachers News Bulletin, May, 1945.
11. Junior and Senior High School Students Go to Syracuse University for Their Annual Science Congress. The Science Teacher, April, 1946.
12. An Evaluation of Some Materials Useful in Teaching Elementary School Science. The Science Teachers News Bulletin, May, 1946.
13. The Science Teacher and "Basic Issues in Secondary Education." The Science Teachers News Bulletin, November, 1946.
14. Science Education Workshops at Syracuse University. Education, February, 1948.
15. An Outline of a Proposed Program in Science for New York State Grades One to Twelve. The Science Teachers News Bulletin, April, 1948.
16. Some Community Resources Used in Teaching Elementary School Science. The Science Teachers News Bulletin, April, 1948.
17. The General Science Handbook, Part I; Bureau of Curriculum Development. New York State Education Department, 1951, Coauthorship.
18. Editor. The Welch Biology and General Science Digest, 1951-1956.
19. Biology Study Guide for Montana High Schools. Montana State Department of Public Instruction, August, 1952.
20. The General Science Handbook, Part II. Bureau of Curriculum Development, New York State Education Department. September, 1952.
21. Science Education through Radio. The Bulletin of the National Association of Secondary School Principals. Vol. 37, No. 191, January, 1953.
22. Ask the Biologist. The Science Teacher, Vol. XX, No. 4, September, 1953.
23. Microscopic Study of Living Leaves. The American Biology Teacher, March, 1954.
24. The General Science Handbook Part II. Bureau of Curriculum Development, New York State Education Department, September, 1955.
25. Fundamental Teaching Concepts. Proceedings, Teachers Seminar on Pharmacy, Ameri-

can Association of Colleges of Pharmacy, September, 1955.
26. The Southeastern and North Central Conferences on Biology Teaching. The A.I.B.S. Bulletin Vol. VI, No. 1, January, 1956.
27. The Biology Teachers Work Center at Purdue University, The American Biology Teacher, Vol. 18, No. 3, March, 1956.

Rx for Good Teaching*

RICHARD ARMACOST, *Purdue University, West Lafayette, Indiana*

I can't teach you to teach. If I had this ability I, too, would be a better teacher. But I do think I can give you a prescription for good teaching. The effectiveness of this prescription, like that of any prescription, depends on the physiological and psychological state of the patient. For one thing he must not be allergic to teaching suggestions. As you well know, allergies frequently make it impossible to prescribe certain ingredients. I hope none of you leave after this speech with the hives or even an antagonistic itch.

The patient must also desire to have the ingredients work. He must want to become a good teacher because he believes good teaching is important. If he has the incurable disease, antiteachingitis, no prescription can help. In case you are not familiar with this malady, let me remind you that there are many symptoms.

Diagnosis is usually made from such evidence as: lack of interest in students, a general lack of enthusiasm in the classroom and laboratory, and above all the firm conviction on the part of the diseased that the subject matter involved is such "good stuff" that students should want to learn it regardless of how it is presented. A secondary infection usually follows which is characterized by verbal flogging of the class for lack of interest, poor test results, and poor attendance.

"How shall we teach what we teach?" asks Dr. Samuel Meyer, Head of the Department of Botany, Florida State University, in a paper which I shall give you after this meeting. He points out that there is no *one* best method, but that all methods have their elements of strength and their elements of weakness. He says, "Different people teach most effectively by different methods. No one method need be used to the exclusion of the others, and no one is better than the others. The best teaching undoubtedly results from a combination of clearly defined objectives, carefully selected materials, and the method best suited to the teacher's own talents." I hope you will read Dr. Meyer's paper carefully, at your leisure, and profit by the many fine suggestions given for the lecture, the discussion, and in my opinion, the most important method of all—the discovery.

Any phase of any subject can be divided into: introduction, assimilation, organization, conclusions, and evaluation. Before trying to teach, the instructor first chooses an area in his subject because it fulfills certain objectives of his course. In introducing it, he should develop interest and at the same time give a "bird's-eye" view of what is coming. Too many areas start with such statements as: "Today we are going to discuss *etc. etc.*"

I once had a graduate student who wondered how to start the day's lecture on stimulus-response. I told him to start it with a bang—but even I was startled when he set off a firecracker in the front of the room. You don't always have to start your teaching with a major explosion, but it helps. I don't think most teachers spend enough time organizing their thinking on how to begin. Many times the class is lost in the first few minutes of the hour—never to be regained.

Assimilation simply involves activities students have had or are assigned which help them in their study of an area. Experiences outside of class, experimentation and field trips, reading, visual aids—all are important in getting a student ready to organize and discuss what he is supposed to be learning. The problem here is that so many instructors never seem to know what or even if their students have assimilated the desired material. Organization is the art of molding together ideas, by discussion and questions, so that conclusions can be reached. My suggestion here is to get students to argue a little. Too often we get an answer, shake a head affirm-

*Presented before a meeting of the American Association of Colleges of Pharmacy, Butler University, Indianapolis, Indiana, August, 1955.

atively, and go on; or we give students all the answers. Evaluation is simply what it implies —placing values on significant and diagnostic activities in the course.

By now I suspect some of you are shaking your heads negatively and saying "It won't work, my classes are too large." In classes over 35, you'll have trouble with discussion and organization. But even if you have to lecture all the time (which I doubt) you can introduce the subject in an interesting manner, plan varied activities for assimilation, and evaluate in terms of your major purposes.

At Purdue University, we have a graduate seminar in the Department of Biological Sciences, designed to help our graduate students become better teachers. This is one of the most interesting seminars I have ever had the pleasure to develop. The outline of the program is attached. We must select from this material, because we never have time to cover it all in one term. We have some good discussions, summaries of which frequently go back to our staff members in the various areas. It is the only seminar I've ever been in where faculty guests show up without being trapped and dragged in. Some come, I think, in self defense; others come out of curiosity. But the spirit is good and we're all trying to improve teaching. Some of our summary sheets are also included in this paper. There are many specific suggestions for good teaching, and I would like to emphasize a few of those listed.

No, I can't teach you to teach. But perhaps you may be able to help improve yourself and others by using the prescription offered here today.

THE TEACHING OF THE BIOLOGICAL SCIENCES IN COLLEGES AND UNIVERSITIES

Course Outline	*Representative Assignments*
I. Some reasons for including the biological sciences in a modern college or university program.	1. List major objectives of your University.
The biological sciences as a part of general education.	2. List major objectives of your department.
The departmental biological sciences.	
II. Basic courses and sequences in the biological sciences.	
III. Selecting and organizing the content of courses in the biological sciences.	
Developing a course.	3. How would you proceed in the development of a general education course in biology?
Planning for a class or laboratory period. Teaching methods: lecture; lecture-discussion; lecture-demonstration; laboratory, field trips and other community resources; reading-discussion; assignments.	4. Analyze "a successful class." 5. Develop a written plan for a class or laboratory.
IV. How to choose a text. The textbook and reference book systems.	6. Compile criteria for choosing a text.
V. The use of audio-visual aids.	7. Theory and practice in the use of audio-visual aids.
VI. Evaluating and recording student progress.	8. Test item construction.
VII. Classrooms and equipment.	9. What things should be considered in computing a final grade?
VIII. The library.	
IX. Suggestions for pursuing a research problem.	10. Replan a classroom.
X. Professional growth: organizations and publications; teaching load; basic responsibilities.	
XI. Relationships with: other teachers; students; administration.	

XII. Some suggestions when appplying for a position.

11. Write and criticize letters of application.

Some Suggestions for the Improvement of Classroom Teaching.
(Compiled by: Seminar in the Teaching of Biological Sciences, Biology 691, first semester, 1954-55).
Purdue University

I. Respect the intelligence of your students.
   A. The instructor should not set himself up as an infallible authority.
   B. Interruptions for the sake of clarity and comprehension should be encouraged.

II. Attitude of the instructor
   A. The general attitude of an instructor should be one of helpfulness.
   B. The instructor should strive to have the students have a feeling of trust in him.

III. Presentation of material.
   A. Presentation should vary, and personality of instructor should be given consideration.
   B. At all times, the instructor should be concerned with the maintenance of student attention.
   C. The instructor should try to be natural as contrasted to aloofness.
   D. The instructor should try to develop an interesting manner of presentation.
   E. Material should be presented in a logical, planned way (at least show some reasoning of development by the instructor).
   F. An instructor should show enthusiasm.
   G. If an instructor used notes, blackboard, or the like; he should still maintain eye and/or verbal contact with his students.
   H. Informality, within reason, relaxes students and can help improve learning.
   I. An instructor can help a student by recognizing and relating information from one course to information in another course.
   J. In small, homogeneous classes of students, particularly in advanced courses, project work and student sponsored discussions can be valuable.

IV. Audio-visual aids.
   A. A blackboard, properly used, is a helpful visual aid.
   B. Mimeographed material can supplement text and reference book material and serve as notes in parts of a course.
   C. Other types of audio-visual aids are useful when they do not replace living material or first hand studies, but are used because the above are not available.

Some Suggestions for the Improvement of Laboratory Teaching
(Compiled by: Seminar in Teaching of Biological Sciences, Biology 691, first semester, 1954-55).
Purdue University

I. Proper directions.
   A. Give a clear, concise explanation of laboratory procedure. Avoid giving long speeches.
   B. Carefully explain techniques to be used for the first time and point out errors commonly made in a given type of laboratory work.
   C. Demonstrate laboratory procedure, whenever possible.

II. Respect a student's effort, and encourage him to ask questions during the laboratory period.

III. Conducting the laboratory.
   A. Develop a spirit of informality, but under no circumstances permit any "horsing around."
   B. Plan for an adequate core of material to be studied, but don't try to cover too much.
   C. Discuss laboratory work with individual students from time to time.

IV. Equipment.
   A. Have enough equipment for each student, if possible. Group use of equipment is not usually recommended.

B. Check equipment before laboratory time.
C. Be sure you know how to operate or use equipment.
D. Don't overuse student in preparation and cleaning up of laboratory.

V. Demonstrations.
A. Be sure they work.
B. Don't fake results.
C. Explain each step of demonstration.
D. Discuss results.
E. Plan so that ample time is available and demonstration is not going on at the sound of the bell ending the period.

A Neglected Pool

For the past few years the National Science Foundation, among its many projects, has sponsored institutes for secondary school science teachers. Teachers throughout the country have lauded these institutes for the tremendous assistance that these programs have offered in bringing their present day scientific information up to date, their laboratory and field activities supplemented and enlivened, and their power to encourage the gifted science student strengthened.

It has been my good fortune to attend two such institutes by grant and another by paying my own way. The first one was by a small grant in 1956 when the grants were small in comparison to the larger ones of today, and this may account for my good fortune of being selected again.

At these institutes it was possible for me to learn the latest information from the top scientists of the country. For example, a topic such as photoperiodism, among other items, was covered at three institutes by men such as Fuller of Illinois, Galston of Yale, and Leopold of Purdue. Latest advances and laboratory activities in endocrinology were treated by Breneman of Indiana and Zarrow of Purdue. Beadle of California Institute of Technology, Herskowitz of St. Louis University, and Riley of Kentucky discussed new items in genetics and heredity. Then there were Heiser of Indiana and Tippo of Yale on plant classification, and such other able teachers as Postlethwaite of Purdue, and Konetzka of Indiana. These are but a few from the wealth of talent which was made available.

As the years have gone by, more and more teachers have attended two or more such institutes. Here it seems is an often neglected pool of resource personnel for forthcoming institutes. These secondary teachers have often gleaned "the best from the best" for their own uses. Not only have they obtained a vast fund of information, but they have practiced and tried the various applications in their own secondary school situations. Other teachers could thus learn and appreciate much that these teachers could offer.

It probably still should be the policy of the National Science Foundation Institutes to heavily stress subject matter information with highly competent scientists divulging the recent findings in their particular fields. However, it would seem that as the number of institutes has increased, each institute could well afford one of these institute experienced secondary school teachers on its staff.

It was my good fortune to serve as one of the staff at an institute at Morehead State College, Kentucky, under the directorship of Dr. William Owsley. The experience was a very rewarding one, one which it is my hope that more teachers can participate in in the future.

If you are directing an institute in the near future and agree with this idea, why not write to one of your outstanding previous participants to teach a course or two in your program? If you are from the neglected pool of which I speak, why not write to the various institutes offering your services for this summer or the summer following?

PAUL V. WEBSTER,
President-elect.

Biology's Bright Future

Paul Klinge, *Indiana University, Bloomington*

This paper was given as the Presidential Address at the NABT meetings with the AAAS in Chicago, December, 1959. It is respectfully and lovingly dedicated to Dick Armacost by its author who worked with Dick as Co-Editor and was considered among his best friends.

So much has been said recently on science education—by qualified persons as well as by those who simply want to get into the act—that little more needs to be said. I am tempted to follow the example of those famous comedians, Laurel and Hardy, when in their most frustrating moments, Mr. Hardy would yell at his hopelessly entangled friend, "*Do something!*"

The idea of this as an annual affair of this organization came from a mandate of the Board of Directors in its last meeting in Washington, D. C. However, the scheduling of this first Presidential Address is frightening indeed. On one side, it has been preceded by distinguished curriculum experts, and on the other side, it will be followed by the address of a distinguished Nobel prize winner. I feel like the "other" speaker at the Gettysburg Address ceremonies.

The story is told about a nervous young executive who was about ready to give his first major speech. While riding on a train before the talk, he encountered an old family friend, the Rev. John Howland Lathrop. In answer to a plea for help, Dr. Lathrop said: "Let me give you some advice that has stood me in good stead over many years in the ministry. As you mount into the pulpit, you pause, you raise your head high, you very slowly survey all of the hundreds out in front of you, and to yourself you say quietly; 'You go to hell, You go to hell.' "

"And then," Dr. Lathrop said, "You can then buckle down and proceed to save their souls."

Many phrases and statements have been uttered so often in the past four years that they have become common-place clichés. For instance, the terms "scientific literacy," and "biological literacy," are now very popular terms. I suspect that our distinguished founder, Dr. Oscar Riddle, was responsible for these fine phrases. I noticed that recently a very well known annual science symposium used these terms as the theme for all of its talks.

Another often used term is "quality courses." President Sproul of the University of California had the idea when he warned: "If we fail in our hold upon quality, the cherished American dream of universal education will degenerate into a nightmare."

Too, the idea of "science for all" is another widely used phrase. The distinguished science-educator, Dr. Lee DuBridge, has written: "Science is the study of some of mankind's greatest intellectual achievements. The method of science is one important method by which the human mind may grapple with the problems that we face. Finally, the spirit of science, like the spirit of true liberalism, is the spirit of freedom."[1] And thus he too adds his voice to the many who are telling us that science is a subject that *must* be in the curriculum of those who go through our American schools. Science has become an important subject in the school curriculum, and certainly in the minds and lives of all citizens—a subject of great significance and importance.

There is no doubt that in this "cold war" in which we are so hotly engaged, we find ourselves without the very weapons we need so badly. These are the exportable commodities which we must have in great quantity to send to foreign countries which are in the "undecided" classification. The exportable commodities are American citizens who are scientifically literate, and consequently, are in the best position to assist these countries in

[1]Lee A. DuBridge, "Science and the Liberal Education." *Engineering and Science*, Vol. XIV, April 1951, p. 10.

their struggle for a better life. We know that Russia is able to export this type of commodity—and a very fine product it is—to almost any country in the world upon a moment's notice. We find ourselves in the position of being unable to do this after the long drought of science in education of the last 30 years.

The questions which all of our speakers in science are asking are the same old questions. However, it has become obvious that the answers are new. The professor who was called into the Dean's office and admonished for giving the same exam year after year, had the best reply possible: "I give the same exam year after year, but the answers change."

The Importance of Biology

I suppose that many of those on the outside of the biological area look upon us as fine examples of advanced cases of paranoia. But biology *has* been ignored in the march of science emphasis in the past few years.

An expensive, large, and high powered symposium on science recently had not one speech concerning biology. The National Aeronautics and Space Agency has revealed its rather nebulous knowledge of the biological sciences by labeling a new division, the Division of Bio-sciences.

Examples could be multiplied *ad nauseam.* Curriculum reorganization which is going on in many schools throughout the country often ignores the place—the true place—of the biological sciences in the total education of the child. Biology in these cases becomes relegated to an introductory general science for all students without any regard for different abilities. The emphasis is on the physical sciences in many places. Indeed, the public and most nonscience school people have the mistaken idea that science is confined to physics, chemistry, and now possibly, astronomy and geology. In such situations, a new course in electronics is encouraged—but not advanced biology. In our guidance and counseling services, we come across countless instances where bright science students are encouraged to go into engineering and physics and chemistry but not into biology.

Physics and engineering are confused in the public mind to almost a hopeless degree. The physicist is quite upset with this fact and is desperately trying to show the difference between applied and basic science. While the physicist often does not suffer from this confusion, because grants and money come in great quantities, his basic research sometimes finds increasing difficulty in getting the support which he must have to do the work on which engineering feeds. In the minds of the public, and even in the minds of many physical scientists, medicine, agriculture, and the entire gamut of the biological sciences are hopelessly confused. If it is not applied science, to these minds, it is not science. And thus, biology must depend upon much of its support for its applied phases. However, there seems to be some hope on the horizon.

When we consider that biology is the course taken by most students, and most often the terminal course in science, these confusions and misunderstandings become rather serious. Not only has this confusion taken its toll in the research activities of biology, but it has taken its toll in the understanding by students of biology.

It is time that we became proud to be called a professional biology teacher among other science teachers and among the professional biologists themselves.

The Science of Biology

The gamut and range of this science of which we are a part is indeed broad. The spectrum of the biological sciences goes from the most minute and careful work in cytology and the biochemistry of cells to the applied phases of agriculture and medicine. And physics has this similar gamut from its area of mechanics to the other end of the spectrum, atomic structure.

But just as physics had to have large, unifying concepts before it could make its real progress, and be called a discrete science, so must biology have these large and important ideas. They now seem to be rather definite, and it is these large ideas which will make biology a discrete and well defined subject that we will all soon be able to talk about more intelligently.

Diversity and Unity:

There is great diversity—yet remarkable unity—to life as we now see it. The science of bio-systematics emphasizes the great diversity of living forms, yet there is evidence

in great abundance that there is a unity in all of these forms. Ranging from the viruses and bacteria to the higher plants and animals, the student must be lead to see this diversity but under no conditions be allowed to escape the basic fact that there is a supreme unity throughout. This uniformity of nature is basic to scientific research, and biology has this. We recognize that life is indeed a dynamic process and that even the succession of life and death is also a process.

Evolution:

The large, encompassing idea of evolution, the centennial of which we now celebrate, is another one of these ideas which serves to emphasize biology as a discrete science. While this great diversity of life as it exists today is evident—and its unity also—we now know that this diversity spreads in another dimension—time—and this diversity which is truly immense, exhibits again the basic unity of life. What more important concepts must a subject have to be called a science? Yet there are others.

Genetics:

The science of genetics has become still another one of these major theories. What Professor David Goddard has called, "inherited and acquired information" seems to have many analogies in computing machines and electronic equipment calculated to predict.[2] The organism does have a genetic code—inherited information. We can make some accurate predictions of how this genetic code will be established. Yet there is a substantial body of prejudice against this idea which biologists must fight against for many, many years to come. Characters which we have assumed as unimportant in the genetic constitution of an individual now turn out to have important connotations and bearing on the total characteristics of the organism. The chemical constituency of the cell, genetically organized, now is shown to be the determinant of much of the behavior and operation of the organism. Here is another large idea in the biological sciences.

Cellular Biology:

The fields of cytology and biochemistry offer intriguing possibilities how life itself may become a controllable process. As we further understand the cellular composition of the organism, and its intricate and almost fanciful biochemical organization, we find out that this knowledge is of great significance if we are to think about the future of living things.

Ecology:

The subject of ecology is such a broad one that many have been unable to grapple with its major ideas. There is no doubt that the balance of nature is a complex network in many dimensions—that disturbances in one area have repercussions of varying degrees in many other areas of living things. The idea of conservation sometimes may become an emotional point with some people, or it may become a matter of very hardheaded economics. The "population explosion" which we hear so much about lately is really an ecological problem and must be looked at with all the biological knowledge we can muster. The problems of disease and food production have now spilled over into the fields of social science. Too often social scientists are ignoramuses in the field of biological sciences. The subject and concepts of ecology, discovered in very small environments, are often completely ignored by these people who are grappling with the primary problems that human beings will have today and in the next century.

Biology—The Science of the Future

So distinguished a physical scientist as Vannevar Bush has written: "There has been a great blossoming of the biological sciences. They are moving out of empiricism into logical order. There is fresh understanding of subtle matter—in genetics, in enzymology, in embryology, in the role of hormones, and the nature of viruses. There are already applications in medicine—antibiotics, vitamins, hormones—in the fermentation industries, in agriculture. But in the whole field of biological applications a dam is about to break, and a surge forward is ready to occur, just as in the physical sciences, the fundamental discoveries of centuries finally led to the present day of thermonic tubes, transistors, television, atomic energy."[3]

[2]David R. Goddard, "Educating For Scientific Literacy," Address at Edison Foundation Institute, New York, November 19, 1959.

[3]Vannevar Bush, "Today's Research and Tomorrow's World," Address at Stanford Research Institute, Los Angeles, January, 1954.

The horizons of biology are bright indeed. We are about to see a glorious sunrise in this area which has been preceded by startling shafts of light in beautiful colors. We already see the visions of tremendous light—and many of us are indeed afraid.

Other Forms of Life:

What is the possibility of other forms of life? This unanswered question received unscientific attention in the past centuries of human existence. Now the answers to this question appear to be of a predictive nature, and indeed, one which may be experimentally decided. The distinguished geneticist who will follow me, Professor H. J. Muller, has this as the subject of his address. This is the type of question biologists are now asking. What, indeed, will the future hold?

Directed Evolution:

Evolution is now a proven fact. We need only argue and discuss some of the "hows" and "wheres" and "whens" to this problem. But now we see that evolution can be directed, and this control is frightening. Man must become very wise in order to deal with the great power that will be in his mind when the idea of evolution as a directed process becomes a distinct possibility.

Chemistry of Genetics:

The science of genetics is making tremendous strides in its discovery of the precise mechanism of how we are and what we are. When the biochemistry is more completely understood, the implications of future control of the genetic constitution of organisms becomes another possibility.

Control of the Cell:

The more we know about the cell and its chemical environment, the more we know about the precise chemical intricacies of the cell, the more we are convinced that this power will give us another frightening aspect of human society.

Applications of Ecology:

The population pressure which has been building up propounds and compounds problems in the field of ecology. And this field is rapidly becoming the field which must be used before social scientists may adequately make some of the recommendations which they invariably must. Biomes now are to be considered not simply as little closed systems within discrete parts of the world, but, indeed, the entire world is a biome of a complexity which we have seldom before found necessary to understand. Add to this tremendous concept the idea of space travel, and we find that this sector of biology must receive great attention if we are to remain as human beings on this planet called earth.

Biology *must* be the science of the future. It is obvious from all of the discoveries and advances which are occuring in this area, together with the intricate relations which it has with the other fields of human endeavor, serve to make it *the* important subject to which the best minds in the world must devote attention. I am quite confident that the science of biology will be able to sustain the great amount of attention which it will receive, but this attention must be built on the large, unifying concepts which have been proposed over the many years.

Building Biological Literacy

Are we ready for this bright future in our biology teaching? While the professional biologist is busy, are biology teachers aware of these rapidly and alarming discoveries which are occurring in their science? Are biology teachers really biology teachers of 1959—of the next ten years—of the next three decades—or are they still content to talk about biology as a subject of a rather diffuse nature and confused emphases? Will the biology teacher offer the same stubborn resistance which the teachers of the natural sciences in the past century offered to the rapidly developed discoveries in the physical sciences? Are biology teachers indeed ready for the future?

Teacher Certification:

The patterns of teaching, and teacher training, are changing quite rapidly. Yet all of these national movements—even those on a state and local level—must be translated into the operations of the teachers in the classroom. The time lag between these operations must be shortened immensely if the preparation for the future is to be adequate enough. Certification and preservice training of teachers has been undergoing extensive revision in the past few years. The TEPSS Conferences have done much to spur this movement on. Our own participation in the Cooperative

Committee's work of the AAAS along this line is also noteworthy. Individual institutions of higher learning, and many states, have also taken the initiative in changing the certification requirements for teachers.

The Laboratory and Its Equipment:

There is an abundance of new equipment available to biology teachers. Under the National Defense Education Act equipment is being made available in large quantities. The Purchase Guide written for the use of teachers ordering such equipment is another noteworthy achievement in the effort to improve the type of laboratory experiences in biology. The laboratory period itself is being looked at very intensively, and the Michigan State Sourcebook, written under the auspices of the National Research Council, is one of these outstanding achievements toward the improvement of the biological laboratory sessions.

Aids, Films, and Texts:

New teaching aids of a great variety are appearing. Textbooks have become colorful, and publishers are keenly alert in making the maximum use of new theories of textbook writing and in the subject matter itself. The recent blast of a distinguished biologist against one textbook which omitted the word "evolution" has served to make publishers quite attentive to the real changes which are occurring in biology. The film industry is producing exceptionally fine works in its area. The AIBS Film Series is a tremendous effort to put on celluloid the best than can be put there of a modern course in biology.

Curriculum Reorganization:

The idea of homogeneous grouping for ability levels in the sciences has now become a standard in many areas of the country. The values of such an administrative device can become obvious to all who have used it. Only the small schools are in the position of being unable to use this very efficient idea for instructional improvement. The AIBS Biological Sciences Curriculum Study is still another laudable effort being made to look at the biology curriculum with a great deal of care. While still in its infancy, the Curriculum Study has every promise for producing a major impact, and one which will produce important recommendations for the improvement of biology instruction for many years to come. It is a major purpose to have professional biologists involved in the Curriculum Study rather than allowing only classroom teachers to reorganize the curriculum as has been done so often in the past. When the most prominent biologists in the country take an interest, and put their minds to work on such an important problem, their teamwork with the professional teacher becomes one which is bound to have good results.

National Science Foundation:

The extensive program of the National Science Foundation, a program which has received increasing support from Congress, in the field of improvement of science education, is one of the outstanding features in this country of the real and determined effort to do something about what goes on in the classroom. If teachers need any evidence that the community is ready to support real, intelligent efforts for improvement, the extensiveness of the NSF program is evidence indeed. The many programs which are now offered for teachers, as well as high school students, promise to be a major "bootstrap" program in this improvement.

Role of the Biologist:

Now we see, in many places for the first time, professional biologists taking a keen interest in what is going on in the elementary, junior high, and secondary school classroom. However, their attention must be focused on what is being taught, rather than emphasizing how it is being taught. The professional biologist is interested in getting the student to have a certain body of modern information, but most importantly, an attitude toward biology as a real, experimental science.

All of these are healthy signs. But, again, the time lag between these major efforts and the translation of their results into practice in the classroom cannot afford to have the comfortable interval which we have seen in other areas.

The Role of the NABT in Biology Teaching Improvement

Statesmanship:

The outstanding need in our professional organization of biology teachers is statesmanship. Statesmanship is a very difficult word to define, but everyone has a rather

complete picture in his mind as to precisely what it includes. We are in need of real leadership in the field of biology teaching. These leaders must have the ability to see what the television producer has called "the big picture." They must be persons who recognize that change is one of the important characteristics of biology. And this change is something that must be lived with and lived with comfortably. Personalities with high intelligence are required—but personalities also with character. We do not need demagogues, or panacea preachers, or technical tub-thumpers, or professional lint-pickers, but *statesmanship* is our most obvious need.

The true scientific statesman must be a man who has these characteristics and have the immense drive to see that things get done. Kahlil Gibran, writes in his book, *The Prophet*, "God rests in Reason and moves in Passion and, as you are breath in God's fear and a leaf in God's forest, so you, too, should rest in Reason and move in Passion." The biological statesmen which we need so desperately must indeed rest in reason and move in passion.

How may we obtain these statesman-like leaders? The NABT must actively build up a leadership pool. While this is the most obvious statement to make, the difficulties in obtaining this are quite great. We need high school teachers who are of a high professional status. We may obtain these recommendations, I believe, from NSF Institute directors, from our regional directors which this association may soon have, from those who publish and who write for professional journals, from science supervisors throughout the country, from those who find it possible to be active in NABT affairs, and from the recommendations of the professional educator and biologist who knows first hand who the quality teachers are in this country. While these are all obvious sources of our leadership pool, it will require a considerable effort on the part of this organization to see that these names are collected and used.

Experimental Teaching:

Still another major effort must be made on the part of the NABT to encourage as broadly and as widely as possible an experimental approach to teaching. We are not looking for *the* answer to a better biology course, but we are looking for better answers. If we settle on *one* course in biology which is *the* course, we have made a serious error—one which belies our training as science teachers. When new approaches are discussed and written about for the teaching of biology, one must carefully propose them as tentative ideas for the *possible* better answer to our problems. Far too often, the teacher who has tried a new approach becomes like the circus pitchman, loudly declaiming his wares, and refusing to accept any other possibility as legitimate. The major curriculum studies, especially the AIBS Curriculum Study, must be thoroughly inhabited by intelligent and wise high school teachers. Of course, the professional biologist has a major role to play in this study, but the wisdom of the professional teacher must be heard and not ignored.

Cooperative Projects:

In this encouragement to new ideas—an experimental approach to better biology teaching—the NABT must work, and work actively with other groups. The AIBS Curriculum Study, and other such activities, must be an integral part of the NABT program. But, in addition, we must make a concerted effort to make contact with groups of school administrators of all varieties to tell our story, to emphasize what we think must be done, to offer our services so that school administrators may not be left in a vacuum in which they talk to each other as the Lowells in Boston. I think that such groups are now quite receptive to approaches which we may make in helping them work out these knotty science curriculum problems. In addition, we need the closest of liaison with other science teachers, with their professional organizations. Biology cannot stand alone in the school curriculum, but neither can the other sciences. The NABT must take a strong role in approaching this problem of the coordination of the science experiences of the student, and this must be a cooperative venture. Joining forces need not necessarily mean combining organizations for we have found how quickly biology in this way becomes submerged, but it does mean that task forces from all science teaching groups must get together for these integration problems.

Cooperation of the Professional Biologist:

The NABT as the largest group of professional biology teachers has still another duty—to improve the *quality* of biology teaching in this country. It must encourage, stimulate, and actively incite the cooperation of the professional biologist in this business of better teaching. The services of professional biologists are now being offered, but far too often, this cooperative open-hand has been spurned with the idea that "we do not want a college man telling us how to teach," or "what can a professional scientist tell us about *our* problems," or with such phrases as, "no one understands what I have to put up with in my school." The AIBS Curriculum Study is a major effort to include the outstanding professional biologists in the country in this business, but there are many other instances where this cooperative work is going on, and NABT must be in the business of encouraging it to a greater degree. Through its journal it has always asked for professional biologists to write articles that will be pertinent to the biology teacher. These are very difficult to come by. In the NSF Summer Institute program, and in many of its other programs, professional scientists come in close contact with the teacher, and the interplay of minds and backgrounds in these situations has been most rewarding for all concerned. This should be encouraged, and encouraged, and encouraged.

Local Teacher-Biologist Relationships:

Every teacher should feel confident that he can walk into a nearby industrial laboratory and especially, university laboratories, and talk about some of the problems with which the professional biologist can help him. The professional scientist is quite reluctant to offer his services to schools when he knows the bitter reaction that many teachers have against such "college" aid. The professional teacher must make the first approach in many instances, and the NABT has as a major problem the business of making teacher and scientist more closely acquainted. Every biology teacher must become so well acquainted with some professional scientist in his area that he feels free to talk to him and visit him in his laboratory. And then the scientist will also feel free to come to the school, and visit, and offer his services also. While this is being done in a very successful manner by the American Chemical Society, and the AIBS Visiting Lecturers Program is a forward step, the biologists have been notorious for their backwardness in this relationship. It is time for the NABT and the professional teacher to offer the open hand.

Of course, I speak with a "union card" that registers 15 years of high school teaching experience, even though I am now on the faculty of a very distinguished university. But, we must be wary of the "Johnny Come-Latelys" in the business of science education who wish to peddle very odd wares and wish to sell us a bill of goods which has not received the experimental background which must be present. The NABT must be the organization that encourages legitimate contact between the professional teacher and the scientist.

Professionalism:

Another major effort on the part of the NABT should be to encourage a feeling of professionalism among biology teachers. We are in a profession of high calling. President Gould of Antioch College writes: "To leave a vestige of oneself in the development of another is a touch of immortality. A teacher is a person with a touch of immortality, and he should be the most envied among men." The professionalism of biology teachers needs every encouragement from its organization, the NABT. For example, we must encourage more desirable certification practices.

But teachers themselves have the large responsibility to encourage professionalism—over and above the program of their organization. For instance, they must never lose enthusiasm for the business of teaching. While this is another cliché, its truth is obvious and paramount. Teachers must develop a pride in their work, not obsequious, but real and sincere. Work with our organization is often one in which the teacher must take initiative. He must use the services of the organization. Perhaps he will attend meetings, write articles, serve on committees, at great personal sacrifice. The sacrifice must be made if biology teachers are to remain a professional group.

Self-Education:

Lastly, in his professional growth, biology teachers must never stop to educate themselves. Failure to do so can be the death knell

of teachers, and one need only visit a few schools to find where life has ceased in the intellectual area of some teachers. I understand that in the Hebrew language there is no phrase for "the learned man;" there is only a phrase for the "learning man." I think the lesson of this is most obvious. It is our great task in remaining professional teachers.

Conclusion

The NABT is an organization. And an organization is its members. But we are members collectively, and in that is a new factor of strength. We can all cite analogies of organisms where the simple collection of cells involved is not enough to explain the beauty and the intricacy of the organism. Life itself is made up of many parts, but the collective organization of these parts is the real definition of life. And the living NABT cannot be simply a collection of members, of subscribers to a journal, or of passive listeners in an audience. The collective impact of the membership as large as the one which NABT boasts will have the factor of strength when all of its members work together in the organization of which we are proud. The NABT must have projects of a major nature to sustain and to keep the huge organism going in a directed manner. We are actively working on many of these projects, and they require a great deal of preparation. I am sure that the new President will be happy to report in 1960 some of the successful results of the efforts which have gone on in the past year along this line.

We must look forward to increased publications—an expanded journal—and many other services to the members. More members must become involved in the processes of the NABT. This has been the theme throughout this talk, and all of this centers back to the organism itself.

To quote from *Cell and Psyche*, by Professor Edmund Sinnott: " . . . it is not the character of the constituents of a living thing but the relations between them which are most significant. An organism is an organized system, each part or quality so related to all the rest that in its growth the individual marches on through a series of specific steps to a specific end or culmination, maintaining throughout its course a delicately balanced state of form and function which tends to restore itself if it is altered. This is the most important thing about it."[4] Herbert Muller puts it this way: "Although parts and processes may be isolated for analytical purposes, they cannot be understood with reference to the dynamic, unified whole that is more than their sum. To say, for example, that a man is made up of certain chemical elements is a satisfactory description for only those who intend to use him as a fertilizer."[5]

The National Association of Biology Teachers is in truth a living organism. And it is the relations between its parts which are most significant. Its individual members, its statesmen, its feeling of professionalism, its willingness for experimental approach, its close relations with other allied areas—this will make it a true organism that has direction. This is indeed its time for greatness.

Biological literacy is our goal—but this is only possible with a new professionalism. Biology has a bright future, and with it biology teaching. But this is true only if biology teachers are ready to accept and live with its terrible urgency and its challenge. I have every confidence that we shall meet it, not as we have in the past, but as we know we must in the future—if indeed the world is to have a future at all.

[4]Edmund Sinnott, *Cell and Psyche*, University of North Carolina Press, Chapel Hill, 1950, pp. 20-21.

[5]Herbert J. Muller, *Science and Criticism*, Yale University Press, New Haven, 1943, p. 107.

Brain-Blood Barrier

A brain-blood barrier, intended by nature to protect the brain and nerve centers, may also impede or block potentially helpful drugs. Many substances pass much more readily from the blood stream into the fluids of other tissues than they do into the brain and nervous system fluids. Thus far, the barrier can be broken down in experimental animals only by measures so drastic that they are fatal.

The barrier may be made up of two parts. One part consists of the cells in the walls of the brain's blood capillaries, which "demonstrate a uniquely thick and solid arrangement" making them more "leak proof" than capillaries elsewhere. The other part is in a special membrane of nerve cell material wrapped around the brain capillaries. Each part screens certain materials in the blood plasma.

The Use of a Pond in a Biology Course

CLARENCE J. GOODNIGHT
Purdue University, West Lafayette, Indiana

Dr. Clarence Goodnight, Professor of Zoology, Purdue University, was one of Dick's best friends. Their friendship grew into a close collaboration on the forthcoming high school biology text to be published by Scott-Foresman Company. As Dick termed him, "That man is a persistent needle." When work needed to be done, it was Clarence who provided the spur and the encouragement. They both began collaboration on two other books last year. Close to Dick in his Summer Institute work, it was Clarence who picked up the reins and carried on this work when Dick was killed.

Those schools that have a small pond or lake nearby are fortunate. By means of both field trips and special projects, teachers and students can find materials here for nearly all sections of their biology course.

While I have always enjoyed aquatic ecology, I was further impressed with the possibilities of the uses of this habitat study for students by Dr. Armacost. Dick always loved to bring various animals in from our local ponds, keep them in aquaria, and exhibit them to his student teachers. He especially liked the vertebrates, such as the frogs, turtles, and fish, and he was able to keep them in the laboratory with remarkable success. His interest also extended to the many unusual invertebrates and algae which were brought in from our local ponds.

Almost any group of animals which is not confined to the ocean may be found in nearby ponds. In size, these animals vary from the single-celled protozoans, the rotifers, and worms to the aquatic birds and mammals. Impressive as this array of forms is for a field study of the "variety of living things," the manner in which various types adjust to the rigors of pond life is of even more interest. In a modern functional biology course, these adjustments can give special meaning to sections on anatomy, physiology, evolution, behavior, and ecology.

Animals and plants living in ponds face a variety of "stresses." Small ponds may freeze in winter or dry up in summer. Even a large permanent pond may partially freeze in winter, and much of the shallow area near shore may be exposed in the summer. The fresh water medium is hypotonic to protoplasm of the animals and is continuously entering their bodies. It must constantly be removed to maintain a proper osmotic balance. Because ponds are small and discontinuous, animals and plants must have a way of spreading from one area to another. A study of how aquatic animals and plants have met these and other stresses can be a very rewarding review of many principles studied in the biology course.

Probably the most studied group of invertebrates are the protozoans. For such a study, the pond provides a variety of material for the teacher as well as many interesting experiments and projects for the student. A small jar of algal mats brought into the laboratory and studied under the microscope reveals a great variety of protozoan types and activities. There is enough to send the teacher and the ambitious student to a handbook for identification of the more unusual species. At the very least the student learns for himself that there are many, many more protozoans than the Amoeba, Euglena, and Paramecium of his textbook. The pulsating contractile vacuole takes on new meaning when he realizes that this is the way the protozoan is maintaining his osmotic balance. Protozoan cysts provide the answer to the problem of how winter freezing or summer drying is survived. It also explains how these tiny animals can move from pond to pond.

Along with the protozoans there will be many rotifers, nematodes, and a few microcrustaceans. All these will be observed with

interest and studies may be made on their activities. A few grains of carmine added to the water will show the action of the cilia of the rotifers. Perhaps the student will even be stimulated to search through the available books to learn how these animals also meet the stresses of their environment. In so doing, he will learn about nephridial systems and the difference between the thin parthenogenetic summer eggs and the heavy walled winter eggs. This will be an introduction to the concept of parthenogenesis, as well as to bisexual reproduction and the part these processes play in the life of small organisms.

In the fall of the year if one looks carefully around submerged sticks or logs, he will find brownish or greyish clumps of material. If these are taken into the laboratory and examined, it will be shown that these are fresh water sponges. Here is the opportunity to study living sponges for those who are far from the ocean. When studied under a microscope or observed in an aquarium, the living sponge takes on new meaning. In the fall, the sponge will be found to have small, round balls scattered through its tissue. If these are crushed, then studied under the microscope, they will be found to consist of amoeboid cells surrounded by a heavy wall composed of spicules. These are the winter buds or gemmules, and they are the structures which make it possible for the sponges to survive the cold of winter or the drying of summer. Sometimes these gemmules will hatch and grow for a brief time along the sides of a jar in the laboratory.

Dipping along the edge of a pond with a net will usually produce some crayfish. These can be brought into the laboratory and kept in an aquarium. It is interesting to watch them feed and perhaps molt. Certainly when mouthparts are studied during the dissection of the crayfish, their function will be more evident as the activities of the living crayfish are observed. The bottom mud also produces many other interesting types which may be studied and observed in the classroom. Snails of various types, small fingernail clams, leeches, bottom-dwelling oligochaete worms —to name only a few—are always found in abundance. If the pond is large and contains fish, large unionid clams may be found. These too make good aquarium demonstrations, and also are a good starting point for outlining the interesting life history of the clam.

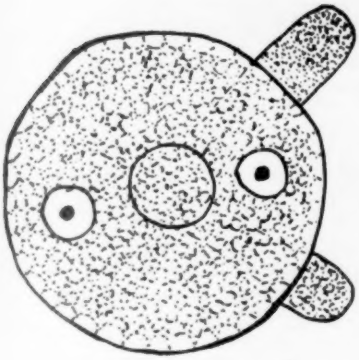
Of course, for those interested in entomology, the pond has further interest. Aquatic beetles and hemipterans can always be collected, as can the nymphs of dragon flies, mayflies, and many others. Midge and beetle larvae as well as the nymphs of the other insects can be brought into the laboratory and reared successfully in a large jar with water and some pond mud on the bottom. During the insect collecting project, the pond species should not be ignored.

To many the pond vertebrates will be the most interesting of all to bring into the laboratory for study. Frogs of several different species are always present, several kinds of turtles, often harmless water snakes, and, of course, several species of fish. The fish that are present in a pond are the usual minnows, sunfish, and bullhead catfishes. Since all these fish live in the severe conditions of a pond where water is often warm and oxygen low, they all do well in a laboratory aquarium. Tadpoles too may be brought into the laboratory and observed as they metamorphose.

In the spring, the pond is alive with many different forms, both microscopic and macroscopic. This is the time to hunt for frog and salamander eggs and to bring them into the laboratory. If these are kept in fresh water they will develop. Under the microscope, there will be a good demonstration of vertebrate embryology. Spring is also an excellent time to observe the activities of birds around the pond. Red-winged blackbirds will be nesting in the surrounding willows; ducks and coots will be swimming in the open water.

The section of the biology course on parasites can also profit from the pond. Snails may be crushed and fluke cercariae observed emerging. Metacercariae will be found as black spots on minnows. Of course, the frogs will yield a host of different interesting flukes and nematodes. As these different types of parasites are observed and life history stages studied, the intriguing life histories of animal parasites become more meaningful.

While we have emphasized the animals that can be studied in a pond, the plants are equally interesting. The drop of water we used earlier to study protozoans will yield an equally long series of algal types. We can also find large masses of filamentous algae for study. Many of the higher plants of the pond



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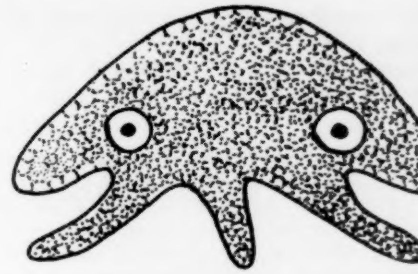

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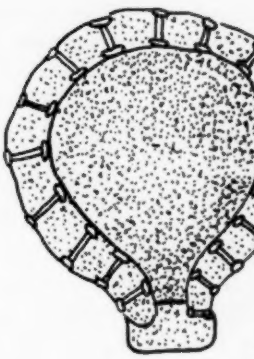

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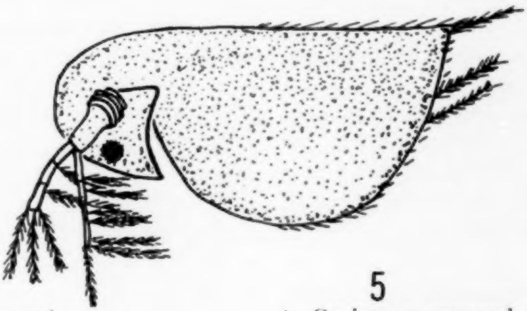

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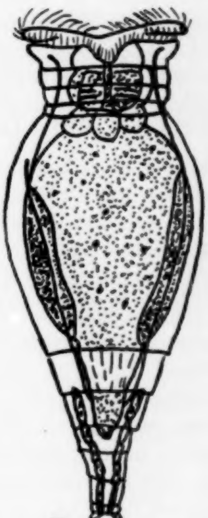

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1. The protozoan *Arcella*, top view.
2. *Arcella*, side view.
3. Section of gemmule of fresh-water sponge.
4. *Cyclops*, a copepod.
5. *Daphnia*, a cladoceran.
6. *Philodina*, a rotifer.

provide material to enrich our aquaria. Also some types of aquatic plants are excellent for experiments in plant physiology.

Of course, if we have time to study the bacteria of the pond, culture experiments here will yield an abundance of various types of bacteria.

The value of the pond to ecology cannot be overemphasized. Here is a closed unit, a microcosm, in which the interrelationships of the inhabitants can be studied and food networks worked out. In the pond it is easy to distinguish the producers, the consumers, and the reducers to get a clear picture of one aspect of modern dynamic ecology.

The pond can provide much of interest for all aspects of biology. It is far more than a substitute for the supply house!

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Biology in the News

Brother H. Charles, F.S.C.

THE CASE OF THE VANISHING BARK, Sports Illustrated, November 30, 1959, pp. M5-M8.

An interesting account of forest regions in the Pacific Northwest where bears are protected to the detriment of Douglas firs planted in cut-over forest regions. This is a good lesson in ecology and forest management.

THE FARM SURPLUS YOU'RE PAYING FOR, Life, November 30, 1959, pp. 22-31.

Good bulletin board material. Wonderful pictures and some discussion of farming in small and in large scale. It could initiate considerable discussion of the farm problem.

A DOUBLE 'A' IN BIOLOGY, Life, December 7, 1959, pp. 76-80.

Wonderful pictures of a tenth-grader's study of chicken embryo's growth. You will want at least two copies of these pictures. Wonderful bulletin board material.

MEN ON A MARGIN, Life, December 14, 1959, pp. 101-111.

The solution of the farm problem is of concern to all of us. This article points out the real issues of the problem. It should provoke productive discussion and alert students to look for related articles coming up during the coming political campaign.

LOS ANGELES BATTLES THE MURK, Arnold Nicholson, Saturday Evening Post, December 19, 1959, pp. 17-19, 90-93.

How one city is trying to control air pollution. Various phases of this manmade danger to the health of most living things in urban areas are described and possible solutions are discussed.

THE MOOSE, Jack O'Connor, Outdoor Life, December, pp. 48-51, 72-76.

A description of the moose and its habits as observed by one who has studied them in their natural habitats. Besides giving facts in an interesting manner it explodes some myths about moose.

WOOD FOR GUNSTOCKS, Jack O'Connor, Outdoor Life, December 1959, pp. 66-71.

Did you ever admire the wood in a gunstock? Where did it come from? What kinds of wood are best for gunstocks? Why? This article gives you the answers. It may cause you to prize some old relic which has passed its shooting days.

PLIGHT OF THE MUSTANG, Dick Spencer III, Sports Afield, December 1959, pp. 28-29, 91.

Wild horses whose ancestors probably date back to the early Spanish horses brought here by the early explorers are hunted and sold for dog food. Should they be protected by law? What is the ecology of this situation?

Book Reviews

COLLECTING, PRESERVING AND STUDYING INSECTS, Harold Oldroyd, 327 pp., $5.00, The Macmillan Company, New York, 1958.

This is a desirable reference book for the school library. It contains a wealth of information but is written so that most high school students should find it easily understandable. The teacher will find it invaluable as a guide for studying insects and as a source of suggestions for natural history projects.

Frank N. Young, *Indiana University*

WORKING WITH ANIMALS, J. Myron Atkin and R. Will Burnett, 88 pp., Rhinehart and Company, Inc., New York, 1959.

Another inexpensive pamphlet in the Activity Series by these authors presents class-tested experiences for the elementary science program. Demonstrations, experiments, collections, and other activities are described. The emphasis is on the use of live material for study and observation of all phyla. Suggestions for setting up aquaria and terraria and instruction for making cages are included. A limited number of line drawings supplement the instructions or directions.

Muriel Beuschlein, Chicago Teachers College

GUIDANCE AND COUNSELING IN THE CLASSROOM, Dugald S. Arbuckle, 397 pp., $5.00, Allyn and Bacon, Inc., Boston, 1957.

This well-written book explains the need for guidance services, the role of teachers as guidance workers, and the processes and methods of counseling. Written for teachers, parents, students and interested laymen.

Education for Future Biological Scientists

OSWALD TIPPO
Chairman, Botany Department, Yale University, New Haven, Connecticut

Professor Tippo is one of the leaders in biological science education who knew Dick Armacost very well—both because of their mutual interest in this field and their mutual interest in all the various problems of the world which are discussed in that inevitable environment surrounding scientific meetings outside of the meeting room itself. As chairman of the Committee on Education and Professional Recruitment of the AIBS, Professor Tippo found Dick Armacost to be, like himself, a botanist, possessing a mutual friend in Professor Harry Fuller, and keenly interested in improving education in the biological sciences. Bystanders will never forget the fast repartee and conversation in which they engaged. This contribution is a revision of some remarks made before the North American Wildlife Conference, and appeared in the 1958 edition of the Transactions of the 23rd North American Wildlife Conference.

It is obvious that in the few minutes allotted to this paper I cannot give an exhaustive and comprehensive treatment of the subject "Education for Future Biological Scientists," since necessarily this would require detailed consideration of education in the elementary school, high school, college and graduate school. I shall, therefore, have to content myself with a few random comments and observations on education at the several levels.

With respect to the elementary school, it is being increasingly recognized that more training in science should be given in the early grades, for the children in these early years have a very natural curiosity which provides an ideal situation for the awakening of interest in science. This, of course, requires adequately trained elementary school teachers. This is not an easy requirement to meet since the teachers must be trained in so many different fields of science—the several physical sciences and the various biological sciences. It would appear that the early grades are ideal for the introduction of what used to be called "nature study." With a little encouragement from teachers and parents, these young students will very readily take to the collection of plants, rocks, insects, snakes, etc. Such collecting activities lead very logically to the study of life histories and ecological relationships of organisms. Trained teachers can recognize at this early stage the gifted child and give him special encouragement. They can encourage such students to build up collections, to make observations in the field, and to maintain aquaria, terraria, and similar groups of living organisms. Such children can be stimulated to read in the field of science. It is from such field studies, such encouragement, and such reading that many a scientist has received his initial impulse to select science as a career. Finally, it would be well if the study of foreign languages were introduced in the elementary school. Again the child in these early years is especially receptive to such study.

Turning to the high school, I think most people are convinced that we should eliminate some of the fads and frills which have accumulated within the high school curriculum, and instead concentrate on the essential subjects. For those preparing for college, I would suggest the following program: (It may not always be possible to follow this ideal program but I think it would be helpful to have such a model curriculum in front of us as something we should strive for.)

1. Four years of English, including grammar, spelling, writing, speaking, literature.
2. Four years of foreign language study.
3. Two years of history.
4. Four years of mathematics.
5. One year each of chemistry, physics and biology.

It is recognized that many good public high schools and private preparatory schools have such a curriculum. Yet, it is shocking to observe how many students reach the colleges and the graduate schools without a foreign language and with little preparation in mathematics, not to mention deplorable training in English. The challenge of the Rus-

sians has emphasized once again the need for a complete change in the intellectual climate of the secondary schools. Hard work must be made respectable again. High school students as well as their parents must recognize that secondary school students must spend two or three hours each evening on homework. High standards of competence and achievement must be established. Those who do not measure up to these standards should be failed. Although I personally am not in favor of using the summer period for formal summer classes, I would advocate that all high school students be required to read eight to ten books during each summer vacation.

Turning specifically to the high school biology course, I will first call your attention to the necessity of having a teacher in this subject who is specially and broadly trained in the biological sciences. All too often high school biology is taught by the football coach or the physical education teacher or someone else not specifically trained in biology. Naturally the subject has suffered from this sort of teaching. All too often the high school biology course is based almost exclusively on the reading of a textbook, whereas a good secondary school biology course should involve laboratory work and field experience. In the past few years I have had the opportunity to examine some two or three dozen high school textbooks; as a whole, I find them full of scientific errors and very much out-of-date. In addition, I find that they lack balance. Some of them concentrate much too heavily on the human body and human physiology; they are woefully inadequate in the field of botany. After all, biology is a study of *both* plants and animals and so any course in the biological sciences which neglects plants cannot claim to be biology. Plants occupy such a basic position in nature that we can ill afford to neglect them. They are the only organisms which are able to take the carbon dioxide of the atmosphere and water of the soil and manufacture food. All animals, including human animals, are dependent upon plants. Therefore, it would seem basic that we study this process of food manufacture or photosynthesis. Then, too, many biological concepts can be introduced with greater effectiveness by using plant materials. And so I think we need to bring high school textbooks up to date, and we must see to it that they present a well-balanced treatment of the biological sciences.

It is my opinion that our educational system would be vastly improved (specifically the high school program would be made more rigorous) and higher standards would be maintained, if all colleges, public and private, were to require entrance examinations. The tremendous increase in young people who are seeking admission to the nation's colleges and universities has already caused an increase in the use of the entrance examination, and I believe that this practice will spread in the years ahead. In some of our private universities four to five thousand applicants are taking entrance examinations for a thousand places in the freshman class. There is every indication that competition for available places will become even more keen in the next decade. It seems only common sense to screen our candidates and accept only those who are prepared for college work.

Turning to the colleges, I think most of us will agree that the task of the undergraduate college is to produce a liberally-educated man—be he a biologist, a chemist, an historian or a student in some other field of learning. With so much pressure developing for the improvement of science teaching in the schools and colleges, there is some danger that the pendulum may swing too far, that biologists and physical scientists will concentrate too much in the fields of science to the detriment of their education in the humanities and social sciences. However, what this country needs is not narrowly-trained technologists or scientific robots, but thinking men who are not only scientists but men of culture who recognize human values. What do we mean by the term "liberally-educated man"? One of the best and most complete definitions which I have read in recent years is the statement made in *General Education in School and College.*[1] "The terms which describe this paragon of perfection (the liberally-educated man) are almost as familiar to educators as the phrases of Jefferson's Declaration. The liberally-educated man is articulate, both in speech and writing. He has a feel for language, a re-

[1]General Education in School and College. Harvard Univ. Press, Cambridge. 1952.

spect for clarity and directness of expression, and a knowledge of some language other than his own. He is at home in the world of quantity, number, and measurement. He thinks rationally, logically, objectively, and knows the difference between fact and opinion. When the occasion demands, however, his thought is imaginative and creative rather than logical. He is perceptive, sensitive to form, and affected by beauty. His mind is flexible and adaptable, curious and independent. He knows a good deal about the world of nature and the world of man, about the culture of which he is a part, but he is never 'merely well-informed.' He can use what he knows with judgment and discrimination. He thinks of his business and profession, his family life and his avocations as parts of a larger whole, parts of a purpose which he has made his own. Whether making a professional or a personal decision, he acts from maturity, balance, perspective, which comes ultimately from his knowledge of other persons, other problems, other times and places. He has convictions, which are reasoned, although he cannot always prove them. He is tolerant about the beliefs of others because he respects sincerity and is not afraid of ideas. He has values, and he can communicate them to others not only by word but by example. His personal standards are high; nothing short of excellence will satisfy him. But service to his society or to his God, not personal satisfaction alone, is the purpose of his excelling. Above all, the liberally-educated man is never a type. He is always a unique person, vivid in his distinction from other similarly educated persons, while sharing with them the traits we have mentioned. A liberally-educated man demands freedom. 'We call those studies liberal,' wrote a Renaissance educator, 'which are worthy of a free man' . . . and we might add today, of a free society. Education designed to free individual human beings from the limitations of ignorance, prejudice, and provincialism makes sense only in a free society and can flourish only within such a society. By a free society we mean one based on the belief that individual persons are ends in themselves, that men are reasonable beings, equal in rights, and that governments exist only to foster their freedom. When totalitarian dictatorship triumphs in the modern world, truly 'liberal education' is the first object of attack, since it is one of the most obvious bulwarks against the brutalization and atomization of the individual. To put the matter another way, a democratic society can never develop if the individuals composing it are merely specialists with no significant knowledge or beliefs held in common. The only way to organize a society of pure experts who have little or nothing in common with each other is through a dictatorship. On the other hand, the ideal democratic society, if there were one, would see to it that its specialists were liberally-educated men. Liberal education and the democratic ideal are related to each other in a thousand ways. It is not too much to say that they stand and fall together."

One should expect, therefore, that the future biologist or any scientist, for that matter, should be exposed during his college years to such humanities and social sciences as philosophy, history, psychology, political science, economics, literature, fine arts, and music. Conversely, the student who majors in the humanities or the social sciences cannot be considered a truly liberally-educated person if he has not had education in the sciences. I think it is indefensible in this day and age in which science and scientific thought loom so large that some of our colleges of liberal arts still require but one year of a science. It seems to me that it would not be too much to expect that a nonscience major take at least one year of college mathematics (including some calculus and statistics), a year of the biological sciences, and a year of the physical sciences. In a slightly different connection it has always seemed an oddity to me that so many of our engineering students leave college with no biology. It would appear reasonable that the individuals who do so much to change the basic landscape with bulldozers and other heavy equipment should know something of the basic principles of biology. They ought to know something about the management of vegetation and something about the structure and functioning of human beings.

Focusing attention specifically on the first course in college biology, I am struck with the great diversity among such courses. I am not one to advocate uniformity, but I do feel that some of these courses are subject to criticism. Some of them seem to have a pre-

medical bias because of the large number of premedical students who are enrolled. And, therefore, there is an overemphasis on the human animal, resulting in neglect of such important areas as taxonomy, ecology, natural history, etc. Many of the courses lack field work, which seems to me unfortunate. Too often the biology course is actually a course in zoology masquerading as biology. The study of plants and botany is short-changed. I would plead for a well-balanced course rather than for the course which has a biochemical approach, or an ecological approach, or a morphological approach. Instead it seems to me that the course should include the important principles and fundamental concepts of all the basic fields of biology, such as genetics, taxonomy, evolution, ecology, morphology, and physiology. Similarly the curriculum for the biology major often lacks balance. Some institutions weigh it heavily on the biochemical side to the exclusion of such classic disciplines as taxonomy and evolution. In other institutions, perhaps too much emphasis is placed on morphology and taxonomy to the exclusion of the newer fields of biochemistry and genetics. The future biologist must not only be liberally-educated in the broad sense, but he must also be well-rounded in the various biological disciplines.

When we come to the graduate school we find that at the present time all too many students enter upon their graduate studies lacking one or both of the required foreign languages. They must use up valuable graduate school time to study languages which should have been mastered in the high school, if not in the elementary school. Because of poor preparation in college or because of faulty counseling, they do not have the necessary basic courses in mathematics, physics and chemistry. Basic training in mathematics, physics, chemistry, foreign languages, not to mention English, are the proper responsibility of the undergraduate college and the high school; the graduate school must put its primary emphasis on individual advanced study and original research.

You may well ask how all these desirable changes are to be brought about. I rather suspect that the whole matter is such a complex and difficult problem that nothing less than a complete reorientation of our national culture and ideals will even come close to improving the situation. Unless the American people develop a real respect for intelligence and the intellectual life, little will be accomplished. Dr. Alan T. Waterman, Director of the National Science Foundation, in comparing research in this country with certain European countries has this to say: "The moral to be drawn from all this is that the relative strength in fundamental research in the European countries is the result of their genuine respect for learning, for teaching, for fundamental research—an attitude which we as a people have never had to the same degree . . . At the present time, the United States lags behind most other countries—certainly all of the leading countries—in the understanding, respect, and prestige accorded learning in general and science in particular." In the words of Alfred North Whitehead: "In the conditions of modern life the rule is absolute, the race which does not value trained intelligence is doomed."

Central in all these considerations is the problem of attracting and retaining a larger number of top quality teachers. The blunt, unvarnished truth is that this will require substantial increases in teachers' salaries, doubling or even tripling present stipends. If the American public genuinely wants more and better teachers, it will have to foot the bill. Society *must* be made to recognize that here, as in all things, you get only what you pay for. If you are willing to pay respectable salaries, you will attract and retain some of the best minds. If you continue the present salary levels, you will be saddled with the misfits, the second-raters, the zombies—and perhaps a few dedicated individuals, but not enough. Professor Oscar Handlin writing in the September, 1956 *Atlantic Monthly* describes the situation as follows: "Salary in our society is an inescapable measure of the desirability of a job. There was a time when the schoolmaster stood very well in the community by that standard. Few occupations now rank as low in terms of earnings as teaching. The average annual wage in elementary schools ranges from $3,000 in small towns to $4,800 in large cities; in high schools, from $4,000 to $5,000." I will spare you the customary comparison of teachers' salaries with those of janitors and garbage collectors.

Recently, the Ford Foundation gave the

privately-endowed colleges a shot in the arm by appropriating $210,000,000 for salary improvement. We need similar efforts on a far more extensive scale and at all educational levels. It has been estimated that it will require $15,000,000,000 in the next decade to bring professional incomes to the level of comparable professions. You will note that this estimate is for professorial salaries only; and leaves untouched the elementary and secondary schools. Beardsley Ruml, New York financier and economist, addressing a Conference of the Association for Higher Education in March, 1956, urged that college faculty salaries be tripled. Under his plan professors would be paid up to $30,000 a year, with an average salary of $15,000. Let us hope Mr. Ruml will be as successful with this scheme as he was in introducing his plan for paying federal income taxes in installments. Few teachers are looking with any great glee to the prospect of swelling enrollments in the next few years. However, one of the expected by-products of the tidal wave of students will be that the law of supply and demand will force salaries to more reasonable levels. In any case, establishment of higher salaries at all school levels is an important, if not *the* most important answer to the problem of recruiting better and more teachers.

Equally important and inescapably linked with the salary question is the matter of status or prestige of the teacher, or more appropriately, the lack of prestige. Professor Handlin, in the same article in the *Atlantic Monthly* cited before, has this to say about the status of the schoolmaster: "Americans have fixed the schoolmaster in a lowly status because he has fallen markedly in their estimation in the last fifty years. The lawyer, the newspaperman, and doctor, are active and powerful. *Mr. District Attorney*, Editor Steve Wilson of *Big Town*, and *Medic* get things done. But who can respect *Our Miss Brooks*, a female eager to be married, but unsuccessful and therefore condemned to remain in the classroom; or her male counterpart, the ineffectual bumbling *Mr. Peepers?* Such people, incapable of the real work of the world, deserve no more than amused tolerance. 'He who can, does. He who cannot, teaches,' goes the old saw; and the nickname 'the Professors' is used with comic disparagement. The caricature is certainly out of place in a society the welfare and security of which depend on its laboratories and its libraries. It is the product of crass materialism but it is nonetheless widely held; and it determines the American attitudes toward the profession."

The salaries and status of high school teachers will be adequate when *you*, as a father, are ready to advise your own son to go into high school teaching. Adequate support of teachers' salaries in the whole education system is possible but it require the complete reorientation of national values. When we consider the millions of dollars which are spent for cosmetics, for tobacco, for alcohol, for chewing gum ($271,000,000 each year), for the control of bad breath and yellow teeth, for the elaborate fins on oversized motor cars, and for the salaries of the Elvis Presleys and the Jayne Mansfields, we need not despair about the available sources of wealth. We need only *the will* to choose what is really important for the national welfare.

I would make a special point here that this plea is not merely for the improvement of the lot of science teachers, in high schools and colleges, but for *all* teachers of *all* subjects at *all* levels. I think it would be most unfortunate if the current hysteria over Russian science should lead to the establishment of differential pay scales for science teachers and to the development of preferential treatment for teachers of science and students of science. We need to improve and support *all* education at *all* educational levels.

New England TV Program

The Children's Museum of Boston, the Massachusetts Audubon Society, and the Boston University School of Education will sponsor a new series of TV programs called "The 21" Classroom." The series will be produced by WGBH-TV. Dr. Charles Wolcott, photographer and special Sylvania Award winner for "Discovery" is director of the project and program producer. Schools in the New England area will be interested to utilize this series in their teaching, and other schools throughout the country will be interested to see how this fine series is effective for possible use in other local areas.

Preparation of Models for Use in Biology Class

ALFRED T. COLLETTE
Syracuse University, Syracuse, New York

The author was Dick's first graduate student and is now Professor of Science Education at Syracuse University. You could readily perceive how Dick infected his students with enthusiasm when you saw Dick and Al in hilarious conversation at science meetings. But perhaps the author's own words are more telling.

"Richard R. Armacost spent ten years of his professional career at Syracuse University as Dual Professor of Botany and Science Education. He instituted a number of special training programs for science teachers which were regarded as 'far-fetched' for the time but are today regarded as outstanding. While at Syracuse Dick had a great deal of foresight. He always had a good idea and strangely enough they were always good! Much more can be said about Dick Armacost's keenness and sense of humor and his leadership in the field of science education, but elaboration is not necessary. He was respected and admired by the students he guided. This article is written in appreciation by one of his students who knew him well."

Classroom situations in biology often arise in which multiple copies of some object or model would be useful. Methods of using agar gelatin to produce molds from which copies in plaster of Paris may be cast have been described in many publications. These molds, however, are seldom able to be used for more than a few casts. This article will describe a mold-making method which uses LIQUID RUBBER (Manufactured by Bersted's Hobby Craft, Inc., Monmouth, Illinois) available at artist's supply houses, and which may be used to produce molds of nearly indefinite life.

1. *Selection and preparation of the original.*—Subject to certain restrictions discussed below, almost any object of any material may be used as the original from which a liquid rubber mold may be made. Preserved biological specimens, fossils, plaster models, and wooden objects are all suitable. The following points should be considered in the selection of the object to be used as an original:

(a) Surface texture and quality.—As far as possible, objects having marked porosity in the surface should be avoided. The liquid rubber used in making the mold will enter any pores which may be present, making it difficult to separate the mold from the original. If the use of a porous original cannot be avoided, this original should be sealed at the surface with shellac or the acrylic resin sold in spray cans as artist's fixative material before the liquid rubber is applied. This is particularly true if the original is unfinished plaster of Paris, since the water present in the liquid rubber will soften the plaster surface, resulting in the destruction of the original and spoiling of the mold. Surface textures can be reproduced with a high degree of fidelity. Skin texture, surface irregularities, and grain will be very apparent in the final plaster cast. In many cases this is, of course, to be desired. Where it is not desired, the surface of the original should be as free from defects as possible to minimize the amount of working necessary on the final cast. As an illustration, fingerprints left in a plasticine original will be clearly visible on the finished model!

(b) Undercutting.—Since the finished mold is flexible, a moderate amount of undercutting in the original may be tolerated. If the model is roughly disc-shaped, however, when the mold is prepared according to the process described below, care should be taken to insure that the undercuts are filled in with the liquid rubber and that the mold itself is not undercut. The relation between mold and original undercutting is shown in Figure 1.

(c) Shape of the original.—The flexibility of the mold allows some freedom of choice in selection of original objects to be du-

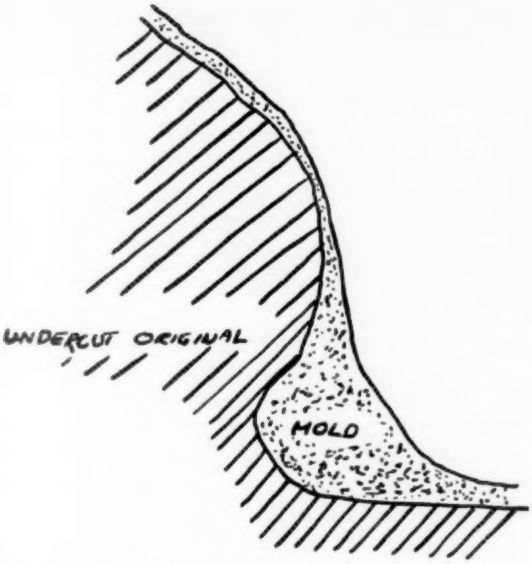

Figure 1. The relation between the mold and the original undercutting.

plicated. A preserved frog, for example, may be duplicated, as well as a frog dissection. Extreme irregularity, however, is to be avoided. Flat, disc-shaped objects present certain difficulties in mold-making, which will be discussed later.

(d) The plasticine original.—In many ways, the plasticine original is most suitable. There is no surface texture or graininess problem, and the shape of the model may be regulated as it is made. The most necessary precaution in the use of a plasticine original is the prevention of surface marls left as a result of the working process. Fingerprints, tool marks, etc., will appear

Figure 2. Preparation of the plasticine original.

in the finished cast, and must be sanded or worked off. Figure 2 shows the preparation of a plasticine original.

2. *Preparation of the mold.*—The mold-making material is a latex suspension which hardens when exposed to air, leaving a flexible rubber mold. The original should be placed on a flat sheet of cardboard. If the side of the original object next to the cardboard is irregular, the space between it and the cardboard may be sealed with plasticine pressed into the space and smoothed to conform to the shape of the original. Enough coats of the liquid rubber to form a mold (about 1/8-3/16" thick) should be brushed on the object so that the thickness of the mold is between 1/8 and 3/16" thick. Normally, 15-20 coats will be adequate. Each coat should be allowed to dry thoroughly before the next coat is applied. Drying may be detected by the color change of the rubber material from a pink to dark red. Figure 3 shows preparation of the mold.

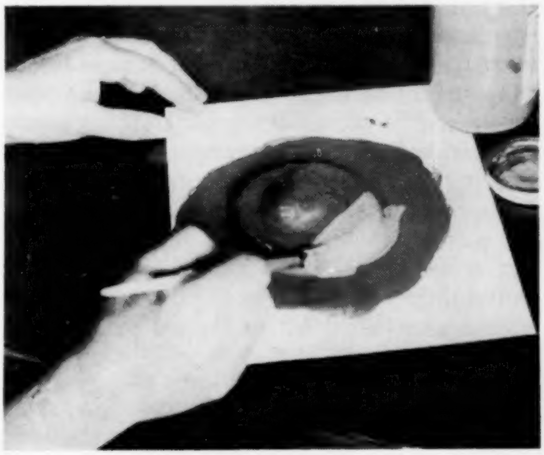

Figure 3. Preparation of the rubber mold.

If the original is roughly disc-shaped, the mold may show a tendency to warp or distort when plaster is poured into it. This may be overcome by pouring a plaster back-up. A cardboard dam is formed around the mold, from which the original has not yet been removed. This dam, which should be about two inches from the mold at all points and four inches higher, may be sealed to the cardboard on which the mold has been made with plasticine. Plaster is then poured into this dam and allowed to harden. When hardened, it will form a support for the mold which will

prevent distortion. The mold itself may, after the original has been removed, be cemented to this back-up with Pliobond cement. In this case, the original should not have any undercutting whatever. Figure 4 shows back-up preparation.

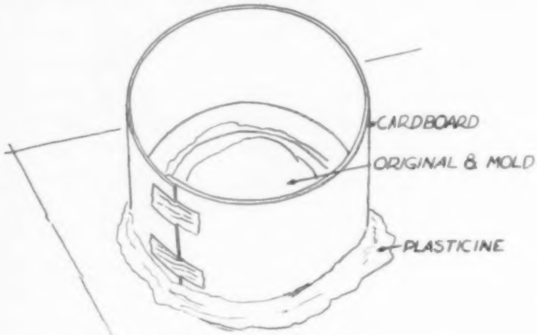

Figure 4. Preparation of the back-up. Plaster is poured into the cardboard dam until the mold is covered to a depth of two inches.

3. *Making the cast.*—Casts are made by pouring plaster directly into the mold. The plaster should be mixed to about the consistency of heavy cream. The container in which the plaster has been mixed should be tapped or shaken gently to bring air bubbles to the surface before the plaster is poured. The pouring lip or rim of the container should be brought as close to the mold as possible, and the plaster should be poured gently and without splashing to avoid trapping air bubbles in the model as shown in Figure 5. The mold should also be shaken or tapped gently after the plaster has been poured to bring air bubbles to the surface.

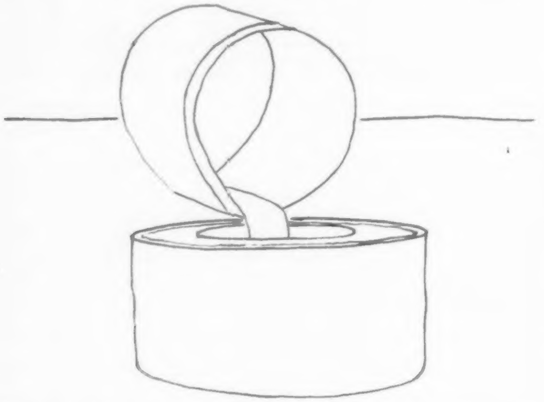

Figure 5. Pouring plaster into the mold. The container is held close to the mold, and poured gently to avoid air bubbles. An old coffee can bent to form a pouring spout is good for mixing and pouring plaster.

The mold should be coated with a separator such as green soap or cooking oil to simplify removal of the model. When the plaster has set, it may be removed from the mold. It should be dried thoroughly before it is finished either by allowing it to stand in a warm place overnight, or by heating it gently for two or three hours in an oven about 150° F.

4. *Finishing the model.*—After the plaster model is thoroughly dry, it may be painted as desired. Any necessary surface preparation—sanding or carving should be done first. Number 400 wet or dry sandpaper works well for sanding, while woodworking tools are satisfactory for carving.

Tempera or poster paints are ideal for finishing plaster models. The paint may be applied directly to the raw plaster, or the plaster may be sized with two very light coats of acrylic spray. The latter procedure will result in a higher gloss on the surface of the finished model. Care should be taken that the sizing coats are not too heavy as this will seal the plaster completely and prevent the poster paint from adhering. After the model is painted, several more coats of acrylic resin should be sprayed on to protect the finish and prevent it from flaking. Figure 6 shows a model which has been finished by the process described.

5. *Mounting the model.*—If desired, the model may be mounted on a suitable stand. Light models may be mounted by glueing them to this stand. Heavier models may be

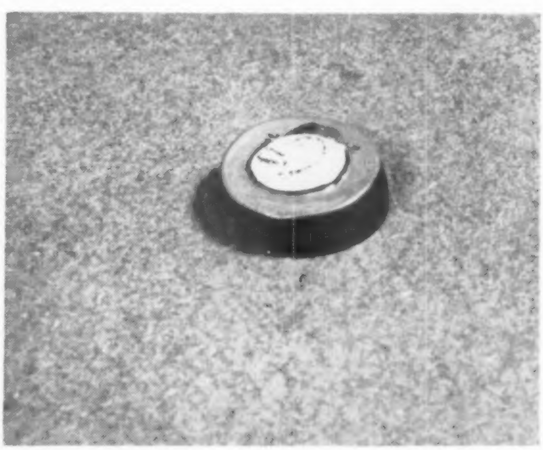

Figure 6. The finished model.

mounted by drilling them for dowels, or by inserting a mason's lead plug. The stands should be weighted, to prevent tipping and possible damage to the model.

Algae in Space

The main barrier to man's reaching other planets may not be heat or weightlessness or inadequate thrust—it may be a question of food. A round trip to Mars, with conventional feeding methods, would require tons of food, water and oxygen for each member of a space crew, since the trip would take at least two or three years, according to an American Chemical Society monthly. Because each ton of cargo requires roughly a thousand tons of thrust, this weight of food becomes unmanageable, it is pointed out.

A possible answer is the creation of a cycle of nature in the space ship, in which man is a part of the cycle. A report from the University of Texas is based on experiments with common algae, or sea weed, said to be "the leading contender" to join man in such a cycle.

Jack Myers, a botanist and zoologist at the university, reports that 2.5 to 5 pounds of the alga *Chlorella pyrenoidosa* can absorb the carbon dioxide exhaled by one man and, in turn, provide his needs for both oxygen and food, with some minor supplementation. This can be continued indefinitely as long as light and nutrients are supplied to the algae, he says.

"Although using algae in a closed system is theoretically possible, there are many difficult engineering problems which must be solved before it becomes a reality. Algae will need illumination, using solar or artificial light. They must be aerated and their population density must be controlled. Scientists must find a way to harvest them and transmute them into a form acceptable as food. They must also design a minature processing plant to handle human wastes. Another problem: controlling the cellulose build-up which is certain to occur. To further complicate all these requirements, there is the all-important weight limitation, plus the fact that the system must operate in the zero-gravity state.

"There are two very strong objections to the use of algae as food for the spaceman. The first concerns the one-food diet aspect; the other concerns algae's aesthetic values—flavor, odor, textural quality—or lack of them.

"Lack of variety is a big drawback. How long a man can stand an unvaried diet is the subject of much debate, but it has been hinted that even the best steak becomes tiresome after three days if that's all there is to eat. And who dares classify algaeburgers with steak?"

Most estimates have it that a closed system will not become practical for at least 10 years, although some are willing to gamble on five years. Most agree, however, that it won't be needed for 10 years because other food forms will satisfy the needs of short space flights.

High School and Mathematics Journal

A new publication for high school students written by them has been issued in pilot form as the *High School and Mathematics Journal*. The editor is Edwin M. Fields, Hellems Annex 318, University of Colorado, Boulder, Colorado. Copies may be obtained from Mr. Fields. It is an interesting compilation of project reports by high school students in the Colorado area.

Another Teaching Aid

Problem Solving Through Science is a new booklet prepared by the Northern California Science Committee as a result of four years work by science teachers in this area. A great many stimulating ideas may be found in the publication for science teachers in all fields. Copies may be obtained from the Committee Chairman, Mr. Eugene Roberts, Polytechnic High School, San Francisco 17, California.

The American Cancer Society has just produced a Filmstrip Kit on "The Cancer Challenge to Youth." The color filmstrip presents the basic story of cancer graphically in a clear and absorbing way. A fifteen minute record accompanies the filmstrip, and its main emphasis is on the nature and history of cancer as a disease and a major health problem. Something about normal and abnormal cell behavior, diagnosis and treatment of the disease is also taken up.

Why College Coordinators of Science Education?

RICHARD L. WEAVER
University of Michigan
Ann Arbor, Michigan

Dick Weaver was another good friend of Dick's who enjoyed the verbal jousts they had with each other. It was always interesting to stand by and listen to their sparring. At meetings one could always find the two arguing about a variety of subjects. They had many things in common, but one was the welfare of NABT. This they both fought for. Professor Weaver is Associate Professor of Conservation and Education at Michigan.

Only a few universities and colleges have full-time science coordinators. Purdue University was one of the first large universities to establish such a position and in fact has two —one in physical science and one in biological science. More recently Indiana University created a position of science coordinator, followed closely by Michigan State University.

Where colleges have had strong science education departments, many responsibilities given to coordinators are handled by science education staff members. Schools such as Cornell University, Harvard University, University of Florida, Florida State University, Ohio State University, Atlanta University, and the University of Wisconsin have been able to provide strong college leadership and coordination. Iowa State Teachers College, Kansas State Teachers College at Emporia, several of the University of New York Teacher Training Units, and several in California have likewise provided strong science education leadership, which have served the college well and also provided national leadership in professional organizations and projects.

Qualifications Needed

Those science educators who have made significant contributions in their institutions and nationally have usually had strong science backgrounds. This has been matched by first hand experiences in public schools and an understanding of public school problems and methods of teaching.

In some cases college scientists or educators have tried to serve in one of these positions without public school experience but usually without great success.

A doctoral degree is now almost a prerequisite for such positions.

An ability to work well and easily with people of varied interests, abilities, and views is also a prerequisite.

Not all college coordinators have been given the same kind of responsibilities, but some of the things which need to be done or are being done by some will be described.

Institute Leadership

One of the newer responsibilities has grown out of the National Science Foundation supported institutes for science teachers and high school students. The preparation of proposals to the Foundation and the directing of the institutes or coordinating the work with students have been handled by science coordinators.

Usually this work involves committees or at least meetings of representatives of various science fields or departments.

Science Methods Courses

Since science methods courses need instructors with strong science backgrounds as well as public school experience and understanding, the science coordinators, if chosen with this combination, are likely the best qualified to teach them. Several do teach such courses.

Science Education Majors

Many times the undergraduate science education majors receive their counseling from college instructors unfamiliar with public schools. Science coordinators and educators should handle these wherever possible.

Likewise in schools without science education departments, the people desiring to do graduate work in science education often have difficulty finding adequately trained and experienced advisors. The science coordinator would be especially well qualified to serve in this capacity in the absence of a science education department.

The science coordinator could work with high schools in the service area of the college to locate and supervise practice teachers in science. Of course, where science education departments are organized this is usually handled by these staff members.

Science Materials Center

Many uses can be made of a science materials center. Teachers in preparation and those in-service need access to the newest in printed and audio-visual science materials and science equipment. Librarians, curriculum committees, administrators and many others will use and appreciate such a center. The science coordinator can organize and supervise such a center.

Purdue University has two centers, one in physical science and one in biological science. This can easily be justified in larger universities. In fact a third one to cover the earth sciences might be feasible.

If courses of study in science, syllabi, and units in science are collected many public school curriculum committees would find it very helpful.

Curriculum Advice and Help

In addition to supplying the above materials, the science consultant or educator should be able to work with public school Curriculum Committees in evaluating their science programs and revising them, or building one if a program has never been designed for all of the grades.

Likewise the science consultant should be able to work with staff members or committees from the various science departments to prepare plans for suitable science instruction for teachers. Coordinators trained and experienced specifically in physical, biological, or earth sciences are likely to be more able to help plan specific courses.

College-Wide Committees

Many larger universities where separate colleges and schools operate almost independently of the other units have special problems which usually need a school-wide committee to resolve. The science coordinator can help establish such a committee and serve as the catalyst to keep it operating effectively, either as chairman, secretary, or project or program director.

Such coordination has been needed in situations such as at The University of Michigan where staff members trained and experienced as science educators located in the School of Public Health, the School of Natural Resources, and the Medical School have desired to help with training high school science teachers, but no coordinating committee was available to permit discussions, planning, and evaluating.

Where teacher-training committees exist, perhaps sub-committees on science education could be established.

Extension Courses in Science

If the college or university is engaged in an extension program, the science coordinator can work with the various science departments and the extension service to see that a rich offering of suitable science courses is offered to teachers at the various centers.

The National Science Foundation has been sponsoring special science courses during the school year which can be offered on Saturdays or in the evenings. The science coordinator can help design the program and assist in the execution.

Professional Leadership

The relatively few science coordinators on campuses have given liberally of their time and services to assist state and national organizations, federal programs, and state science committees. They have held many positions of responsibility and leadership. Colleges and universities have achieved recognition in science education as a result of this service.

Role of National Science Foundation

The National Science Foundation could serve a very useful function by helping colleges and universities without science coordinators or science education services to establish such positions for a three-year period. Colleges could be stimulated to consider the merits of such work by offering financial inducement for the initial period. This would

help the institutions plan more specifically for long-range objectives and not be limited to short-range stop-gap projects.

Conclusion

It is obvious that one person serving as science coordinator could not possibly handle all of the responsibilities described above. He could be very effective in handling some of them and in getting most of the others satisfactorily handled by others. His success might well be judged by the degree to which he could work himself out of the various responsibilities.

The pioneering work of Dick Armacost at Syracuse University and more recently at Purdue University in showing how effectively science coordinators can guide the science education on a large campus will be long-remembered and respected by all of us engaged in science education.

Book Reviews

GENERAL BIOLOGY, 5th edition, William C. Beaver, 775 pp., $6.75, C. V. Mosby Company, St. Louis, 1958.

The presentation of subject matter has been arranged into six parts and numerous chapters so that selections and omissions may be made. Emphasis has been placed on various phenomena including embryonic development and morphogenesis in plants and animals; physiology of muscle contraction; hormones and insect activities; biochemical and biophysical phenomena; genetic improvements; evolution; interdependence among organisms; pebble culture man; diseases; national parks. 445 illustrations.

WOODY PLANTS, IN WINTER, Earl L. Core and Nelle P. Ammons, 218 pp., $2.75 paper; $4.00 cloth, The Boxwood Press, Pittsburgh 13, 1958.

A manual to identify trees and shrubs in winter. Profusely illustrated with line drawings. Covers the northeastern parts of the United States and southeastern Canada. The limits are from the southern boundaries of Virginia and Kentucky, the western boundaries of Missouri and Iowa, and the 49th parallel of latitude through Quebec and Ontario to the northwestern corner of Minnesota.

THE UNCONSCIOUS IN HISTORY, A. Bronson Feldman, 269 pp., $4.75, Philosophical Library, New York, 1959.

These essays are an effort to work out the chief motives of human development. The volume opens with a contribution to analytic theology, exploring the conversion of the Western world to "salvation of the Jews," inquires into the modern mythology of revolution and war as shown by the popular cult of Lincoln the Liberator. There follows a study of character and conscience in nationality and a searching of the hidden springs of social devotion and political pride.

MANAGEMENT OF ADDICTIONS, edited by Edward Podolsky, 413 pp., $7.50, Philosophical Library, New York, 1955.

This volume is a discussion of addictions to alcohol and various drugs by leading authorities in the field. The mechanisms of addiction are thoroughly explored and methods of therapy are presented in detailed form. While this book is intended primarily for physicians, it will also prove of interest to psychologists, sociologists, and others interested in the problem of addiction.

ELEPHANTS, Richard Carrington, 272 pp., $5.00, Basic Books, Inc., 59 Fourth Ave., New York 3, 1959.

This well documented account—rich in anecdotes—relates the natural and evolutionary history of the elephant and describes its role in ancient warfare, in art, religion and folklore, in commerce, and in show business. This is a survey of elephantology told with warmth and humor, coupled with scholarship which will engage the general reader as well as the palaeontologist, the naturalist, and the social historian.

INSIDE THE LIVING CELL, J. A. V. Butler, 174 pp., $3.50, Basic Books, Inc., New York, 1959.

This noted biophysicist and chemist has reduced the many sided inquiries on the nature of life, heredity, growth, old age, disease, death, and the activities of the human brain into a fascinating story. He presents a clear, non-technical account of the make-up of cells, the mechanisms by which they function, their reactions to radiation and other foreign influences, their transformation into the malignant cells of cancer, and their manifold forms of organization and roles in the body.

DICTIONARY OF DIETETICS, Rhoda Ellis, 152 pp., $6.00, Philosophical Library, New York, 1956.

A compilation of terms and references related to diet and diet therapy. Particular emphasis has been placed on the practical application of diet with respect to the background, food habits, economic status, as well as the physiological needs of people inside or out of the hospital environment.

Armacost and the General Science Handbooks

WALTER A. THURBER, *Syracuse University, Syracuse, New York*

The author is a professor of science education at Syracuse University, and it was in the state of New York that he first became acquainted with Dick Armacost. An authority on elementary science education, Walt Thurber was one of his friends about whom Dick always talked with real affection and respect. They had even agreed to collaborate on a book. But the author summarized it beautifully when he wrote the editor, "I have failed completely to describe the part Dick really played in the handbook project—his seemingly casual attitude, his facetious comments, his mocking grin, all of which seemed somehow to bring out the best thinking of those with whom he was associated. But how could I describe this to those who did not know him?"

The three general science handbooks produced by the New York State Education Department have influenced science teaching far outside the geographic area for which they were designed. At least two other states have reproduced them in their entirety. The internationally known UNESCO publication on science teaching is based upon the first two of the series. And several commercial publications have been influenced by the handbooks, some being no more than thinly disguised copies.

The original handbooks list the name of Dr. Richard Armacost as a member of the General Science Syllabus Committee which produced the syllabus on which the handbooks were based. This brief credit in no way gives an adequate picture of Dick's role in the development of the handbooks. Dick was involved in the project from its very beginning and contributed mightily to the original conception.

In the mid-forties, Dick was appointed to the New York State Regents General Science Examination Committee, a committee that was handicapped by the lack of a satisfactory statewide syllabus upon which examinations could be based. As those who knew Dick might suspect, the atmosphere in which the committee worked changed immediately. Everyone was more relaxed but at the same time more attention was given to the accuracy, the conciseness, and the clarity of the proposed questions. Dick had a special talent for showing up muddy thinking in his chosen field of science education.

During the several years that Dick served on the examinations committee the tests were of high caliber. Yet Dick was never happy with them. No matter how sound the individual questions might be, he contended, the examinations could never be truly useful until they were based upon an effective syllabus.

And accordingly Dick continually expressed his dissatisfaction to other members of the committee, to George K. Stone, then in charge of the committee and later head of the Curriculum Bureau, and to Ellis Manning, then state supervisor of science. Dick's comments were pungent, pointed, and provocative. They set wheels in motion.

More and more of the time spent in committee meetings both formal and informal (the latter meetings usually convened in some convenient bar) was devoted to ways and means for developing a satisfactory syllabus. Indeed the committee became in actuality a syllabus committee, hurrying through its official assignment in order to wrestle with the problems of syllabus construction.

Dick and his associates agreed that general science teachers as a whole need more than a list of topics to be covered. These teachers need specific helps both in presenting information and in meeting the broad goals of science education. The committee decided that a looseleaf publication composed almost solely of suggestions for experiments, field trips, demonstrations, and projects would be both highly useful and practical in terms of the funds available. The project was approved by both Mr. Stone and Mr. Manning.

Before work could be started there were departmental changes in organization and in policies which delayed immediate action but which eventually hastened completion of the project. Sufficient money for a bound publication with illustrations became available. Funds were appropriated for special consultant services for collection and testing of suggestions. And at the same time an official syllabus committee was appointed to oversee the project. Dick was, of course, a member of this syllabus committee and served until the project was complete.

From this brief account it should be obvious that much of the credit for the original concept of the handbooks should be given to Dick Armacost. True, we cannot say that the handbooks would never have materialized without him, but we must recognize that in all probability they would not have. His dissatisfaction with anything less than excellent, his persistent "needling," his brilliant suggestions, and his infectious enthusiasm provided the impetus that set others thinking and acting. Looking back we can see that as the handbooks made their way into other states and even into other nations, Dick's influence has constantly widened like the ripples from a stone cast into a pool and that the effect of his mind and personality have by no means come to an end.

Book Reviews

THE STORY OF HUMAN EMOTIONS, George M. Lott, 228 pp., $4.95, Philosophical Library, New York, 1958.

A book for the average person who wishes a deeper understanding of human emotions—his own as well as those of his family, co-workers, neighbors, and friends. Dr. Lott is concerned with the problems and perplexities of *normal* human experience—from the care of the small child, through the stormy rebellions of adolescence, to the more common neuroses from which so many adults suffer.

THE SCIENTIFIC STUDY OF SOCIAL BEHAVIOR, Micheal Argyle, 239 pp., $6.00, Philosophical Library, New York, 1957.

This book is an up-to-date account of psychological research into human social behavior intended not only for students of psychology and other social sciences, but also for industrialists, administrators and all who are interested in the laws underlying social behavior. There are chapters on interaction between pairs of people, behavior in small social groups, and human relations in industry. The author has avoided the adoption of any particular theoretical position and has concentrated on the established empirical findings.

SCHIZOPHRENIA, Manfred Sakel, 335 pp., $5.00, Philosophical Library, New York, 1958.

The Sakel Insulin therapy not only revolutionized medicine's whole attitude toward endogenic psychoses, but has given new life and hope to thousands of mental patients and their families. Here is Sakel's own personal account of his epoch-making discovery, its clinical operation and its consequence for psychotherapy. Part I investigates the theoretical background: the history and description of schizophrenia—the doctors and scientists who contributed to this new branch of medicine—causes and classifications of the illness—symptoms, diagnosis and prognosis. Part II is devoted to Sakel's own clinical description of his treatment, with full medical data and detailed records of many case histories.

THRESHOLDS OF EXISTENCE, Upton Clary Ewing, 286 pp., $3.75, Philosophical Library, New York, 1956.

The author presents a theory of evolution which is far more comprehensive, as both a means and a way of life, than has been heretofore described through restricted analysis. He sets forth evolution as manifesting in the repetition of criteria, a principle through which creation is realized: a principle which approaches the long sought after postulate through which both science and religion may find a harmony in definition. The author portrays the creation of life as the verification of freedom itself. Such a theory dignifies man as a self-reliant creature whose only restraints are the basic ethics of the will to live.

PLANT LIFE, Lorus J. Milne and Margery Milne, 283 pp., Prentice-Hall, Inc., New York 11, 1959.

Plant Life describes the various types of plants with emphasis on economic applications, field relationships, life history, evolution and conservation. It complements and is a companion volume to *Animal Life*.

ANIMAL LIFE, Lorus J. Milne and Margery Milne, 283 pp., $6.95, Prentice-Hall, Inc., New York, 11, 1959.

Beginning with basic information concerning the living processes and variety of life, there follows an outline of the economic importance of animals, and a discussion of the common denominators of cellular construction.

"Please Send Me Everything You Have on Biology"

MURIEL BEUSCHLEIN
Chicago Teachers College, Chicago, Illinois

The close working relationship that Dick Armacost had with Muriel Beuschlein was quite evident not only in the titles which they carried in conjunction with this journal but in the many NABT affairs in which they were mutually involved. Muriel was always a good protagonist as well as loyal and hard-working friend whom Dick dealt with closely. Muriel first met Dick when he was considered for appointment as one of the Co-Editors of the journal back in 1955. Editorial conferences which followed from that time on were quite a joy to attend. There was a banter and a repartee which listeners soon learned to appreciate as sources for conversational gems. Both appreciated the hard work which went into the production of the journal, and they both learned to respect each other for personality as well as quality of work.

This unconsidered request is impossible to fulfill as are innumerable others received by suppliers, manufacturers, and editors. Museums, local, state, and national government offices, colleges and universities, too, are subjected to similar unreasonable and unanswerable appeals.

Samples are in great demand. A recent postcard request begged, "We are studying adaptations of animals. Please send samples." Another student reported the initiation of a conservation unit. He wanted samples of all the natural resources. Expectations are limitless. Letters, postcards, even telephone calls request information, books, live and preserved specimens as well as samples of rocks, butterflies, insects, and anything else that lends itself to collection.

Elementary pupils have added their appeal to those of students in high school and college. Teachers, too, are guilty of making unreasonable demands. A third grade teacher asked for all the science units for the year with sample lessons, tests, and bulletin board material. A recent letter from overseas seemed to be the ultimate in absurd asking. The air mail message read, "Please send me samples of all the science textbooks published by your advertisers. I would also appreciate samples of the many elementary science books that are now available."

What has stimulated this avalanche of applications for charity? Inadequate or nonexistent school libraries, out-of-date textbooks, an abrupt extension of the science curriculum, initiation of a gifted student program have been mentioned as the origin of the need for materials. The many published lists of free and inexpensive items for the particular school subjects revealed a wealth of supplementary material.[1] However, the situation soon got out of hand. Too often it has deteriorated into haphazard, inconsiderate, and absurd demands for unreasonable services—not only for supplementary material but for items included in science budgets or information available in encyclopedias.

The increase of student projects and science fairs and the emphasis placed on individual and small group activities have put a premium on student research, originality, and creativity. The requests sometimes reveal these purposes. The completed project or assignment seems to be the only objective. The processes wherein learning takes place appears to be of little or no concern. A short cut is the easy and quick way out. Individual initiative, planning, research, and creativity are not served by ready-made materials available for a postcard or a four-cent stamp.

The greatest criticism is directed toward those situations in which the classroom teacher initiates an avalanche of requests. A recent batch of thirty-three letters were identical

[1]*Materials for Teaching Conservation and Resource-Use*, Interstate Printers, Danville, Illinois. 35 cents.

Beuschlein, Muriel. *Free and Inexpensive Materials for Science Education*, Supplement of the *Chicago Schools Journal*. Oct. 1959. pp. 72. Available from: Journal Office, Chicago Teachers College, Chicago 21, Illinois. 25 cents mailing charge.

in content, and the items were to be sent to individual addresses in the same locality. There was no evidence of discriminate selection in requesting information or materials. The usual "send everything you have . . . . ." was repeated in each letter. No attempt was made to use the experience to improve the students' letter writing techniques or spelling. The results were shocking!

This appalling situation may explain the abrupt withdrawal from circulation of some materials, the hesitation to continue with a program of distributing free teaching aids, or limiting responses to those written on school stationery and sent to school addresses. Recent publications have called attention to the increasing numbers of student requests.[2] These organizations and others are anxious to cooperate. They are willing to assist in worthwhile projects especially when information is not available in standard texts and references. For example, TURTOX spends an estimated $25,000 a year for bulletins and correspondence to help students in planning and carrying out projects and in addition, a rather substantial sum for awards and prizes to be used in science fairs. In instances where a student requests data on which routine references are not readily available, the TURTOX staff members often spend hours collecting and forwarding data.

What Can Teachers Do

1. Check newest references, texts, and science publications for information on projects before requesting assistance or vague information. Encourage the school librarian to add new items of references as they become available.
2. Make a careful selection of items from lists. Send for single copies of specific items or describe need, topic, grade level, and intended use.
3. Use school stationery whenever possible.
4. Set up a classroom library or file drawer of these selected materials so that they can be used by other students and at other times. Send for available items for this file as they are offered in the literature. Arrange a simple, logical, filing system for student use.
5. Carefully consider your own requests for material. Are you reasonable in your expectations? Are you specific in explaining your needs? Are you courteous in your manner of appeal?
6. When a specific item is especially useful or worthwhile send a note of appreciation or explanation of its use to the supplier.
7. If the request is used as a stimulus for a letter writing experience, supervise the composition and handwriting. Select only those letters which are a credit to your class. Before mailing, add your own note of explanation and your signature.
8. Discourage indiscriminate student requests for indefinite items or materials.
9. Discourage wholesale student requests for materials or samples.
10. Discourage individual student requests for items available in classroom quantities. The teacher should write one letter stating the number needed or send for a sample to check the suitability of the item for specific situations.
11. Discourage student requests for material or information that can be obtained through their own efforts or investigation.
12. Guide and direct each of your students in planning and necessary research for each project. Warn them against the indiscriminate use of free material and predigested data. Help them attain pride in a job well done on their own effort.

[2]Rand, Austin L. "A Scientist Admonishes Teachers and Pupils." *Chicago Natural History Bulletin*, Sept., 1956.
Turtox News, "More About Student Projects." Vol. 35, No. 2. Feb., 1957.

New Publication

Free and inexpensive aids for science education, compiled by Muriel Beuschlein, Chicago School Journal, Supplement, October, 1959.

This is an up-to-date supplement to the original booklet compiled by Mrs. Beuschlein. All entries have been checked as to current availability, soundness of content, and suitability for school use. This may be obtained from the Chicago Public Schools at 25 cents. It contains seventy-one pages of excellent source information for teachers of all levels in the sciences. A very valuable booklet to have on hand.

Textbook Publishing

DONALD McNAMARA
Directing Editor, High School Science, Scott, Foresman and Company, Chicago

By this time the news of an impending high school biology text with Dick as one of the authors is widespread. The authors' meetings with the publishers, more precisely with "Mac," were always eagerly anticipated. With Dick as the spokesman, things moved fast and with little ambiguity. The whip in getting things done was Dick, prodded not too subtly by Mac. The authors learned to appreciate the complexities of the publishing business under the skillful direction of Mac. Too, the solid sense, the well-informed background, and excellent biology know-how of the editor earned for him the very healthy respect of the authors. All of us were convinced we had an excellent editor who not only knew his business but knew a great deal of biology, too. This article was written by one of Dick's very good friends. They appreciated each other.

Among his many other activities, Dick Armacost had for the past several years been engaged in preparing a new biology textbook for high schools. Work on the manuscript was well advanced at the time of his death. After an understandable delay but in due course, the book will be published, bearing his name along with the names of his coauthors, Clarence Goodnight and Paul Klinge. It was as editor of the projected text that I came to know Dick and the others.

Last summer, Dr. Goodnight invited me to talk with with a group of biology teachers who were attending the institute formerly directed by Armacost at Purdue. My talk dealt with the procedures involved in getting out a new text and the kinds of problems encountered. The question-and-answer period that followed was informative, at least to me. For as it progressed, some possibly widespread misconceptions about textbook publishing came to light. I shall try to clear up some of the misconceptions that seem most common.

Many people have the idea that textbook publishers are printers. Some of them are, to be sure, though most of them are not. On learning that I am in the publishing business, people often ask, "How many printing presses does your company have?" I reply, "None." This is substantially though not strictly true. We do have a few small presses for printing some of our business forms and the like. But we print no books whatever. Nor do we set type, engrave illustrations, make printing plates, or do anything at all on the mechanical side of bookmaking. Every bit of this work is done for us by other companies according to our specifications.

Some people think that textbook publishers merely act as middlemen, that is, as brokers and peddlers. The chain of events is assumed to be somewhat like this: A manuscript, complete in every important detail, is prepared by one or more authors, who are school people writing in their spare time. The manuscript is submitted, probably unsolicited, to various textbook publishers. Then the one who accepts it converts it into a book that can be sold in the schools. This idea of textbook publishing is not entirely false, particularly at the college and graduate levels. But at the elementary and high school levels, it is now rarely true. For example, in twenty-eight years of editing about 100 items, fewer than a half a dozen reached my desk as anything like a complete manuscript. The Armacost-Goodnight-Klinge biology manuscript was one of these few. About 80 per cent had been completed when I first saw it, and the rest had been outlined.

For some time now, the trend in textbook publishing has been toward taking the initiative and away from waiting for manuscripts to arrive in the mail. The publisher, represented by his editors, keeps constant watch for curriculum changes involving new content, new organization, and new teaching methods. The editors are in charge of research and development. They examine courses of study, read professional journals, attend teachers' conventions, and visit schools. They are con-

tinually on the lookout for better ideas and people who can implement them. The people are usually harder to find than the ideas. Like a baby, a textbook is easier to conceive than to deliver. Many a would-be author falters when he takes his pen or typewriter in hand. His mind goes blank. What he eventually commits to paper is in some strange language that he would never use in the classroom.

The publisher, in all likelihood, the editor, recognizes what appears to be the need for a new book or series of books in a certain field. He assembles a group of authors, each a specialist in this field or some part of it. For example, let us suppose that the editor is planning to make a new high school biology text. He decides the ideal authorship group should include a botanist, a zoologist, and a high school biology teacher. Such a group was actually assembled for the biology book mentioned above. However, the group assembled itself with no assistance from the editor. Since textbook publishing is a cooperative enterprise, the next step is an author-editor conference. The authors meet with the editor, usually a good many times. Gradually, an outline is developed. Then the work of putting flesh on the skeleton begins.

We are often asked, "Do the authors write the books? Or are the editors really ghost writers in disguise?" The answers to these questions are "yes and no" and "sometimes but not always." At the elementary level, very little finished copy is provided by authors. In fact, the very name *author* is a misnomer. The so-called author is really an authority in his field, who acts as a consultant and critic. The day-to-day working out of details is left to the editor and his assistants. I fail to find anything shameful about this arrangement. After all, making textbooks is not a spare-time job to be tossed off on evenings, weekends, and vacations. It requires full-time effort, often over a period of several years. Competent authors (or whatever you wish to call them) are busy people, carrying on many other important activities besides preparing textbooks.

At the high school level, authors are ordinarily expected to do more of the writing, especially of early drafts of the manuscript. But even here, a good deal of rewriting and original writing is done by the editor and his assistants. They are trained to translate difficult ideas into plain language without sacrificing accuracy. By the time that the final draft of the manuscript is completed, it is usually impossible to tell who wrote what. This is as it should be, for otherwise the book would read like a symposium. I recall an instance where a passage in a certain book was challenged. One of the authors immediately rose to its defense and stoutly upheld it as his own. However, a careful check of the final draft of the manuscript revealed that it had been written or rewritten by one of the editors, namely, me—a fact which I had long since forgotten.

In our company, at least, an editor is charged with much more than seeing that the grammar, spelling, and punctuation in his books are correct. Any competent proofreader can do that. The editor is responsible for every aspect of a book from its inception right up to the time when it goes on the press. Even then, he sometimes has to work with the printer and the binder on special manufacturing problems. Every stage in production is under the editor's supervision. As the manuscript begins to take shape, he consults with the designer who plans the typography and format of the book. He works with typesetters, artists, and engravers. Picture selection is under his direction. Of course, his biggest job is to supervise and train his assistants. It often seems that he is working for them and not the other way around.

Not long ago, I read in a weekly journal for publishers that a certain textbook salesman had been appointed an editor by his company. Now some of my best friends are textbook salesmen. Yet I felt the statement in the journal was not only absurd but demeaning. You can no more appoint a textbook editor than you can appoint a barber, a dentist, or—for that matter—a biology teacher. Textbook editing is a trade, possibly even a profession. It must be learned by apprenticeship to experienced craftsmen. Any reasonably intelligent person can probably learn textbook editing, but learned it must be. Over the years, I have known some textbook salesmen who became satisfactory editors. None of them just sat down at a desk and started turning out best sellers.

Perhaps a fictional example will help make clearer what is involved in getting out a new textbook. The high school science editor has

somehow sensed the need for an advanced biology text aimed at the twelfth year. He talks and writes to a number of school people who have been giving the matter a good deal of thought. From one of his company's salesmen, he hears of a young, gifted teacher in a near-by high school, who has been working on a course somewhat like the one that he has in mind. A visit to the school is arranged. After auditing several classes, the editor decides that this young man is obviously a comer. During a free period, the teacher and the editor talk, with the editor mostly asking questions and noting answers. What printed materials are being used by the students? How and when are these used?

The text is a standard college book for general biology, not really what the teacher would like but the best he can get. For one thing, the approach is almost entirely phylogenetic and morphological. The teacher would prefer more emphasis on evolution and ecology. In fact, he has tried to provide this emphasis by preparing mimeographed materials to supplement the text. He also feels that the course should give more attention to biochemistry and biophysics. Radiation biology is being touched on but rather sketchily. However, he doubts whether he can do much more with these areas, not being an experimental biologist. Then the editor tactfully points out a few deficiences in the course. Since it was developed in the Midwest, it contains too little marine biology for the East, West, and Gulf coasts. Speleologists will probably expect more on the flora and fauna of caves. More help with student activities, especially on basic techniques, is certainly needed. And so on.

By this time, both the teacher and the editor are convinced that they have something, though they are not quite sure what. Collaboration is clearly indicated. This cannot be a one-man job. I shall spare you the details, but eventually a well-balanced authorship group is brought together. Six months have now elapsed, possibly more. No manuscript as yet, just a lot of ideas. The authors and the editor confer. After some debate and compromise, an outline is worked out and specific chapters assigned to each of the three authors. A deadline for turning in first drafts is optimistically set up and cheerfully accepted. The conference adjourns with high hopes. But having been through all this before, the editor crosses his fingers.

Several months pass, and the deadline is reached. Instead of receiving the assigned chapters from each author, the editor gets part of one chapter from one author. Accompanying this fragment is a chapter-length explanation of why the author was unable to adhere to the outline. Nothing from the other two authors. Presumably, they are being held incommunicado. To test this hypothesis, the editor dispatches a terse but on the whole friendly reminder to them—air mail, special delivery, registered. Within a few days, he will have the bad news, whatever it may be. "Why is it," he muses, "that so many want to be authors, yet so few want to write?"

The first reply arrives by return mail. "Shortly after our conference in June, the Dean named me a committee of one to evaluate various aspects of instruction. A complete report must be ready for submission to the trustees at their first meeting in the fall. Naturally, I appreciated the compliment implied in being chosen for this task. It has, however, forced me to neglect my work on the manuscript." Not long afterwards comes an even more plaintive note. It seems that this author spent odd moments in the early summer building a rock garden in the back yard. Somehow, he slipped a disk and has been confined to a hammock ever since. Writing was of course out of the question. In closing, both authors promise that things will move more swiftly once school opens and classes resume. Why this should be true is unclear to the editor.

Fortunately, the editor has not been taken completely by surprise. During the months since the conference, he and his assistants have been filling in details of the outline. They now have what amounts to an abstract. From it, a rough office draft of several chapters has been prepared. To get things moving, this draft is sent to the authors for criticism and elaboration. Something is, after all, better than nothing. As copy trickles back, the manuscript begins to take form. Finally, there is enough for a representative sample. This is turned over to the designer with general suggestions for typography and format. The designer studies the sample and works out the type specifications, very probably coming up with something different from what the edi-

tor suggested. Eventually, the editor and the designer reach an agreement. Perhaps a few sample pages are set in type to see what the inside of the book will actually look like.

Now the time has come for the editor and the designer to sit down with a production man and get some figures on how much the book will cost to make. Before the production man can estimate the costs, he needs to have a good deal of information. How many pages will the book contain? What is the size of each page? The type area per page? How will the type be set? How many pieces of artwork will there be? How many photographs? What will the average area of the illustrations be? Will color be used? If so, how much and where? What paper is needed? How will the book be printed? Bound? Is the cover to be printed or stamped? How many colors on the cover? And there are more questions. After consulting typesetters, engravers, printers, and binders, the production man arrives at an estimate of costs. They are staggering. Will the potential market for the book justify them? The editor answers, "Yes." What he really means is "I hope so."

Months have now become a year, and the end is nowhere in sight. Fewer than half the chapters are in anything like final form, ready for typesetting. What is even worse, the chapters are not consecutive. Some are much too long. Space, like time, is the editor's constant foe. Unless these chapters are cut in length, the book will run to more pages than originally planned. More pages will increase the estimated costs. As a result, the selling price of the book will be too high to attract many customers. Bugs have begun to appear in the outline. This was to be expected, but it must be remedied. The editor calls a conference with the authors. The tone of this meeting is rather less optimistic and cheerful than that of the first one. Writing a textbook is pick-and-shovel work, the authors now realize. Authorship is not nearly so glamorous as they once thought.

In a few days, what seem to be satisfactory solutions to the major problems are worked out. Editing of the manuscript can again proceed. The manuscript is checked, rechecked, and re-rechecked for accuracy, completeness, simplicity, and consistency. This pale statement can hardly convey the true flavor of the editorial process. To an author who has never before endured it, editorial scrutiny has the ferocity of jungle warfare. If comments are a reliable guide, the editor and his assistants evidently believe that the manuscript was written by someone not only lacking in professional qualifications but also bordering on illiteracy. Seemingly, every word, sentence, and paragraph is challenged. There is good reason for this severity. The editor knows that the finished book will get the same kind of treatment. He is merely taking out insurance.

Well, fictional or not, if this book is ever going to come out, it will have to move along. Completing the manuscript will take from six to eight months. Editorial production will require about the same amount of time. Since the two jobs can overlap to some extent, another year seems a fair estimate for them both. Editorial production involves getting the manuscript into type, making up pages, selecting illustrations, having them engraved, and making printing plates. It sounds so simple. Yet there will be the usual mishaps and setbacks—proofs lost in the mail, pictures upside down or on the wrong page, typographical errors and omissions, last-minute revisions due to revolutionary discoveries. Somehow, though, the book does come out. The authors are proud and happy. The editor is happy, too, but amazed. From the very first book that he worked on, his amazement has never ceased.

Preventing Scars

Unsightly scars may be prevented or erased chemically if an agent found in the pancreas fulfills its promise. The new agent is an enzyme named procollagenase, found in an extract of hog pancreas, according to Dr. John Houck, who is director of the Children's Hospital's biochemical research laboratory of Washington, D. C. It may also be obtained from the pancreas of other animals, he added.

Disfiguring scars consist largely of collagen, a fibrous protein that is found throughout the body, the chemist explained. Collagen, the substance which holds the body's tissues and joints together, makes up from one-half to three quarters of body protein. The enzyme procollagenase can dissolve the collagen form known as procollagen or acid-soluble collagen, from which the tough fibers develop, it was observed.

Have a Nice Summer?

KENNETH BUSH
West Lafayette High School, West Lafayette, Indiana

As Ken so modestly states, he has been an assistant director for two Purdue NSF Institutes, and earlier attended one at Indiana University as a participant. He knows whereof he speaks. Ken knew Dick well because of the close association of the high school and the University. As Dick's assistant in the Institute he discovered another part of Dick's work which took a great deal of time.

Upwards of 20,000 secondary school science teachers have answered this question with enthusiasm this fall. They have been enthusiastic because they have spent a summer studying at a college or university, mostly of their choice, delving into fields of science in which they are most interested. In addition to satisfying their intellectual interests, these same teachers have been reimbursed by the National Science Foundation at a rate which enables them to support a family through the summer months.

Let's disregard the monetary reason for having a nice summer. We know this exists. What other efforts go into having most of the 20,000 teachers willing to say the summer was enjoyable and worthwhile?

The director of an institute is a real "man behind the scenes." To a director of a summer institute falls the responsibility of arranging the formal program of the institute. Few participants realize the amount of time a director spends sitting down and talking "program" with each staff member having a responsibility in the program. It is he who points out that there will be varied backgrounds and preparation. It is he who selects the offerings most likely to be interesting and worthwhile.

I have had the pleasure of working with two institute directors, both of whom were very concerned with having a summer program to satisfy as many as possible. The late Dr. Richard Armacost, Purdue University, and Dr. C. J. Goodnight, also of Purdue, devoted much more time than meets the eye to planning and preparing for a eight week summer institute.

Preparations actually begin in July for the next summer's work. It is then that the proposed budget must be made up and the program tentatively planned in order to meet the National Science Foundation deadline for institute applications. After notification of approval of the program in November, the director must then plan and arrange for printing of brochures announcing the institute. This sounds relatively easy, but agreements must be made on room and board, classroom facilities, recreational facilities, registration and other such items before any announcement is made to teachers.

Then comes the rush of requests for applications, mailing and receipt of completed applications, analysis of applications, selection of participants, notification of acceptances, replacing those unable to accept, sending out vital information to all expected participants, personal letter responses, and, during all of this, the working out of a definite program from the tentative agreements made several months earlier.

The careful balancing of the budget for such an institute must also be worked out well in advance of arrival of participants. The sum of $100,000 might at first sound like a sufficient amount to allow for most anything during an eight week period. This is an erroneous conclusion. Approximately three-fourths of the grant is already allocated to participant stipends, travel allowance and university registration. The remaining amount must be carefully administered for such expenses as scientific equipment, expendable laboratory material, travel for field trips, visiting consultants' fees and expenses, secretarial assistance, and salaries for laboratory assistants.

Ah! Now we are ready to begin the institute! Just a few minor items to clear up. Personal letters from most of the participants must be answered. Their problems include housing for families, health, finances, accreditation, and numerous others, all of which are very important to the individuals involved.

While this is all going on, the director writes 50 or 60 letters to various book companies and scientific supply companies requesting books, literature, and demonstrations which might be of value to the participants. There is a never-ending list of "little things to be done.

Taking care of 65 people who work together, eat together, and play together for an eight-week period is quite a challenging problem. It is a problem because these people have come from all over the country and are in a strange place.

Arranging for study facilities, audio-visual equipment, and laboratory needs must be worked out in advance. Transportation arrangements have to be made for field trips and schedules strictly adhered to. Requests for individuals for special equipment and supplies are also honored within reason.

Special meals such as box lunches for field trips, early breakfast, late dinner, and other special requests are handled by the director. Complaints, if any, about meals are received by the director and must be passed on to kitchen personnel in a tactful manner.

There must, of course, be recreation for such a group, if there is to be anything accomplished in a short eight-week period. This can be an unusually long period with all work and no play. Ball games, picnics, family get-togethers, swimming, golf, all get their share of attention with the assistance of the director who knows where to get equipment, where to play, and how to make arrangements. Numerous little things will again go unmentioned but not forgotten.

Dr. Armacost and Dr. Goodnight knew every person in their institutes personally long before the institutes were terminated. They accomplished this by eating with the people, by playing with them, by conferences in their offices, and by having their homes open to them. They did it because they were interested in you as a person and as a teacher.

Those of you who attend an institute next year, and enjoy it, remember, the person responsible will be the director. Have a nice summer!

Attention Photographers!

The AIBS Biological Sciences Curriculum Study would like to include many new unpublished photographs in the books it is designing for the secondary school biology course. Others will be needed for the elementary school program. Such photographs may also be used in the pamphlet series the Curriculum Study is planning. The BSCS would greatly appreciate receiving pictures of biological subjects for possible use in the proposed publications and requests that as many teachers as possible assist in this endeavor in which we are all so interested. Black and white prints are solicited. The name and address of the owner, and a suggested caption, should be firmly attached to each photograph. They may be sent to the Director, BSCS, University of Colorado, Boulder. Full credit will be given for any picture that is used with reimbursement according to our schedule of rates. Prints will be retained by the BSCS office unless other arrangements are made in advance. For further information about the BSCS program, please write to the above address and ask to be put on the mailing list for the NEWSLETTER.

New Teacher Aid

The National Biological Supply Company, 230 W. Superior St., Chicago 10, Illinois, is offering a new service to biology teachers. Their *Teacher Outline Series* includes a pamphlet on *Invertebrate Cultures* which gives detailed instructions for keeping various protozoa, algae, Hydra, Planaria, vinegar eels, rotifers, Daphina, and Artemia in culture. This valuable booklet is available upon request to the above address.

Fellowships for Higher Education Administration

The Center for the Study of Higher Education of the University of Michigan has available fellowships for 1960-61 in College Administration and for predoctoral students who are interested in research in the problems of higher education. The first group of fellowships has a maximum of $8,000.00 while the second varies in amounts from $1,000.00 to $3,000.00. Application for these may be secured from the address above, and the deadline for application is February 1, 1960.

Book Reviews

PSYCHOPATHIC PERSONALITIES, Harold Palmer, 179 pp., $4.75, Philosophical Library, New York, 1957.

A study of the nature and character of the major mental disturbances, particularly schizophrenia and the manic-depression psychoses by a leading British psychiatrist.

WORKING WITH PLANTS, J. Myron Atkin and R. Will Burnett, 64 pp., Rhinehart and Company, Inc., New York, 1959.

This is the fourth of the Elementary School Science Activities series which provides demonstrations, experiments, and experiences for elementary science program, kindergarten through sixth grade. Beginning with the lowest plants and progressing to flowering species, suggestions are made for class-tested activities designed to give the child a better understanding of basic science concepts regarding plants and plant processes.

Muriel Beuschlein, Chicago Teachers College

AGEING IN INDUSTRY, F. le Gros Clark and Agnes C. Dinne, 146 pp., $7.50, Philosophical Library, New York, 1956.

The authors have combined statistical with factual information on thirty-two large and representative manual occupations. The research was carried out in Britain and applies therefore largely to British conditions. The information will interest many industrialists, since it throws much light upon certain of the obscurer problems of employment and senescence.

HANDBOOK FOR DISSECTORS, J. C. Bioleau Grant and H. A. Cates, 425 pp., $3.50, The Williams and Wilkins Co., Baltimore, Maryland, 1953.

This is a guide to the orderly and consecutive display of the structures of the human body.

JOURNAL OF A SCIENTICIAN, Piero Modigliani, 136 pp., $3.75, Philosophical Library, New York, 1957.

This a highly personalized record of philosophic and practical reflections, of modes and ideas, ranging over virtually every subject of interest to industrial, cultured man. The author definitely questions the use of releasing creative energy of the individual from the solid mass of humanity.

THE STRATEGY OF THE GENES, C. H. Waddington, 262 pp., $4.00, The Macmillan Co., New York, 1958.

Discussed are the two most fundamental problems of theoretical biology: the nature of the organization of biological processes which results in living things having definite and characteristic structures, and how evolution brings into existence organisms so well adapted to the requirements of their life that they appear as if guided towards some End. The author develops a theory of evolution less mechanistic than that commonly in vogue and more allied to the organismic philosophies.

INTRODUCTION TO BIOLOGICAL SCIENCE, Clarence W. Young, G. Ledyard Stebbins, and the late Frank G. Brooks, 555 pp., $4.75, Harper and Bros., New York, 1956.

This introductory general book of biological science is centered upon the human organism, aiming to present a picture of the life process as it displays itself in the human species and to portray the relationships between the life of mankind and of the whole organic world.

ERNEST RUTHERFORD, ATOM PIONEER, John Rowland, 160 pp., $4.75, Philosophical Library, New York, 1957.

The greatest figure in the twentieth-century world of atomic physics was Lord Rutherford of Nelson. This man with immense energy and a fine sense of humor will be remembered most for his brilliant and revolutionary research into atomic physics, and as a result of his work, rapid progress was made toward the development of the atomic bomb, the building of power stations, and the utilizing of atomic energy for industrial purposes.

CONSERVATION EXPERIENCES FOR CHILDREN, Effie Bathurst and Wilhelmina Hill, 192 pp., $0.75, U. S. Department of Health, Education and Welfare, U. S. Government Printing Office, Washington, D. C., 1957.

This bulletin is a source of good practices and information for elementary-school teachers and supervisors; it is a compilation of curriculm experiences which boys and girls have with natural resources.

TEACHING SOIL AND WATER CONSERVATION—A CLASSROOM AND FIELD GUIDE, U. S. Department of Agriculture, Soil Conservation Service, 29 pp., U. S. Government Printing Office, Washington D. C., 1957.

As an aid to busy teachers, this bulletin gives practical suggestions to help carry out activities and observations of soil and water in the classroom and out-of-doors.

A BOOK OF CONTEMPLATION, Dagobert D. Runes, 149 pp., $3.00, Philosophical Library, New York, 1957.

Connoisseurs of wit and irony will relish this book of philosophy *at work* as a delightful and

inexhaustible source of epigrammatic quotes. The author lays bare the essence of righteousness which underlies the great religions and systems of thought and on which the thoughtful modern man may base his own faith.

VOCABULARIUM BOTANICUM, 2nd Edition, E. F. Steinmetz, 362 pp., $7.85, Keizergracht 714, Amsterdam, Holland, 1953.

This dictionary contains the translations into English, Dutch, German, and French of about 4000 Latin and Greek scientific words, used in trade literature and in catalogues. These words are closely related to some of the outstanding characteristics of plants.

THE BIOTIC WORLD AND MAN, 2nd edition, Lorus J. Milne and Margery Milne, 530 pp., Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1958.

The authors furnish the basic information of living processes and the variety of life in a lively form. With a superstructure of ideas and descriptive illustrations, they weld together the biological sciences as an undrestandable field of *progress.* Factual examples, word pictures, and profuse illustrations are drawn from the whole of North and Central America with emphasis on no one region.

AUTHOR'S GUIDE FOR PREPARING MANUSCRIPT AND HANDLING PROOF, John Wiley and Sons, Inc., 80 pp., John Wiley and Sons, Inc., New York, 1950.

A modern manual for the scientific and technical author. It gives correct, efficient, and economical methods of accomplishing those phases of editorial and production work for which the author is responsible.

MATTER ENERGY MECHANICS, Jakob Mandelker, 73 pp., $3.75, Philosophical Library, New York, 1954.

Matter Energy Mechanics is based on the energy concept of matter-m c^2; it unifies and extends relativity mechanics by introducing anew *kinetic energy formula* which follows from the fact that the motion of a body whose mass increases with velocity is equivalent to *motion with resistance*, and the work performed is not equal to the kinetic energy but must always be greater.

YOU AND YOUR SENSES, Leo Schneider, 137 pp., $2.75, Harcourt-Brace and Co., New York, 1956.

Young people in search of clear and readable information will find this book absorbing and satisfying. The basic principles and interesting sidelights of the five senses are presented in a logical fashion with numerous diagrams and drawings by Gustav Schrotter.

WOODLAND ECOLOGY, E. G. Neal, 117 pp., $1.75, Harvard University Press, Cambridge, 1958.

Aimed primarily at the student, this book will also be of use to that increasing body of naturalists who, not content with mere records, wish to learn more about the lives and relationships of the animals and plants they discover. Mr. Neal has emphasized the concept of the wood as a whole unit and kept in mind the underlying principles of the many intricate interrelationships, in order to avoid overwhelming the reader with the number of organisms and to give the reader a background against which more detailed work can be carried out.

MCFADYEAN'S OSTEOLOGY AND ARTHROLOGY OF THE DOMESTICATED ANIMALS, fourth edition, edited by H. V. Hughes and J. W. Dransfield, The Williams and Wilkins Company, Baltimore 2, 1953.

An introduction to the systematic anatomy of the common domesticated animals, designed for the use of students of veterinary science and others interested in comparative anatomy. The bones and joints are described in detail as they occur in the horse as the type, while the characteristic features of these structures in the other domestic animals are dealt with as they compare or contrast with those of the horse.

REFLECTIONS OF A PHYSICIST, P. W. Bridgman, 576 pp., $6.00, Philosophical Library, New York, 1955.

This collection comprises the bulk of the technical writings of Dr. Bridgman, together with three papers which are published here for the first time and may be regarded as an extension of the operational approach to problems in other fields than physics.

THIS WORLD OF OURS, Abram Glaser, 492 pp., $5.00, Philosophical Library, New York, 1955.

The author deals deftly with the physical, vital, and psychic forces in the world, the human body, man's mental progress, world religions and literature, and things political, economic, and legal. Underlying the work is a wholesome philosophy seeing in history a progressive development, in the interplay of public and individual interests and demands, toward fulfillment of a divine Will ever striving in men to attain the greatest good for the greatest number.

NATURAL SELECTION AND HEREDITY, P. M. Sheppard, 212 pp., $6.00, Philosophical Library, New York, 1959.

This book deals with some recent ideas on the mechanism of evolution in the light of modern genetics. Special attention has been paid to the

role played by natural selection which under various conditions can cause evolutionary changes in a species or resist such changes and which can decrease or increase variability in a species.

THE IMPACT OF DARWINISM ON SOCIAL PSYCHOLOGY, Arthur L. Beeley, University of Utah, Publications in Philosophy, Series VI, No. 5, 30 pp., Free, March, 1959.

A very interesting report on the implications of Darwinism on the field of psychology and philosophy.

VIRUS, Wolfhard Weidel, 159 pp., $4.50, University of Michigan Press, Ann Arbor, Michigan, 1959.

The cliche so often used is quite a valid statement about this book. It *is* a "must" book for every high school science library. Written originally in German, it has been translated into an easy to read summary of what is known about viruses. The student will be given some beautifully written information about "life," the viruses' reproductive intricacies, pathogenicity, and relationship to cells. The striking use of metaphors to explain the significance of virus chemistry in relation to cell metabolism will long be remembered by the student. This is the best summary on the viruses this reviewer has seen between book covers. P.K.

THE HUMAN REPRODUCTIVE SYSTEM, Thomas H. Knepp, 55 pp., $1.00, Wm. C. Brown Company, Dubuque, Iowa, 1959.

Written for use of high school students as a supplementary text in biology or family relations classes, this book is written in a straightforward, clear manner with ample illustrations. There are some obvious omissions, even if the main emphasis of the book is on the physiology and anatomy of reproduction. No pathology or aberrations are discussed. Minor errors include the human chromosome count and some questionable information on human genetics. No contraceptive information is included. The physiology of fertilization is omitted. All in all, it is a simple, clear supplementary work, recommended for high school students. P.K.

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